Economic geography and the role of socio-natural subjectivity in capitalism: The development of fracking wastewater disposal wells in Ohio

Research Thesis

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by

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ABSTRACT

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Abstract: Through horizontal fracturing (or 'fracking'), the extraction of previously inaccessible reserves of petroleum and natural gas is transforming the United States' economic and geopolitical position. Fracking produces large volumes of wastewater as a byproduct and the disposal of this waste is mostly achieved via injection wells becoming a lucrative market in itself. To accommodate the intense growth of the fracking industry, Ohio developed a comparatively large injection well disposal infrastructure and consequently became the fracking wastewater receptacle state. This development resulted from specific economic geographic context aggregated from the combination of historical, social, political, and economic legacies in Ohio as well as comparative legal frameworks of environmental protections and regulations surrounding the oil and gas industry. In this study I interpret these legacies as a means to understand the function of socio-natural subjectivity. I argue that the socio-natural subject is integral to the existence of capitalism and has continually been reproduced and interpellated into the ideology of surplus accumulation throughout history. The culmination of the social and economic legacies of socio-natural subjectivity pre-determine and facilitate Ohio's being the regions fracking wastewater disposal state. Working from an understanding of the socio-natural relationship that the subjects of capital have with the Earth, I develop a theory for the production and agency of the socio-natural subject of capital today as seen through the vertical territorial expansion of capital via fracking and injection well development and growth. This growth is at once driven by economic imperative while also laden with narratives of American sovereignty and security on a global geopolitical scale within carbon energy markets

CONTENTS

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I. INTRODUCTION

The physical landscape of rural Ohio varies significantly from East to West and North to South. Driving along Interstate-71, one observes the transition from agricultural plains to rolling hills and eventually ravines and forests characteristic of the Southeast. This differentiation stems from the effects of the glacial period, the Pleistocene Epoch, when northwest Ohio was covered in glacial formations, which melted into the southeastern portion forming the ravines, rivers, and mountains that lead into the modern day Appalachian Mountains. As the glacier slowly moved across the state, it smoothed the northern portion and as it melted, deposited minerals and rock into the southeast. The sediment and topography cultivated from events over 10,000 years ago contribute to the cultural and economic developments in Ohio through out history. These sediments and topographical formations have shaped the realm of possibility of certain economic activity in the region. The northwestern area is best for agriculture while the un-glaciated southeastern contained coal reserves, which have been exploited since the nineteenth century (See Figure 1).

The influence of these differences in landscape and the cultural structures that have formed among them, folds into past to present lived experience, sense of place, resource availability. These influences have led to the pervasive presence of extractive industries in the area since the nineteenth century leading up to the current boom in the exploration of unconventional gas reserves via fracking. In this, I examine the social, political, and economic geographic component of fossil fuel infrastructure in Ohio: specifically injection wells necessitated by the wastewater produced as a byproduct of fracking.

The fracking boom is possibly the most dramatic shift in the market of the fossil fuel industry since its advent (Lave and Lutz, 2014). The rise of fracking's popularity infuses other offshoot industries with intense waves of demand and new market opportunities. The industry of wastewater disposal is one such offshoot industry of fracking that has found a home base in Ohio. The practice of wastewater injection thousands of feet into the earth is touted as the preferred, safest wastewater management method and has thus become lucrative consequence of the fracking boom. I contend that, the heavy development of the injection well industry in Ohio is the result of a culmination of factors across time and space with multiple interests at stake in Ohio performing this role as the disposal grounds for wastewater.

I explain why Ohio developed a strong injection well infrastructure and how it performs this role of waste disposal site for surrounding states. These legacies are products of capitalist modes of production as implemented through accumulation strategies. The economic geography detailed by the myriad of legacies in Ohio is only one aspect contributing to injection well development. The other side being, a theory of socio-natural subjectivity within capitalist society and more importantly it's being vital to capital social relations' reproduction. From this theory, I form an understanding of how injection well infrastructure in Ohio is a progressive continuation of the insistent reproduction of the socio-natural subject that instigates the rational territorialization of vertical space seen in the fracking and injection well activities.

This study therefore seeks a critical geographic perspective of the role of the socio-natural subject as constituted through capitalism within the context of injection well development in Ohio. This perspective supports that the socio-natural subject at once implicates and is implicated by the expressions of capital relations through economic, social, and political legacies. As it acts as a manipulating force on legacies, (their contents, frameworks and so on.),

the socio-natural subject constantly changes its relation to the earth in degrees but not in kind to accommodate novel strategies of capital accumulation. In the context of Ohio injection well development, the key strategy is the institutionalization of vertical territoriality legitimated through private property.

Much of the current literature on fracking focuses on the need for more research, adapted regulations, or the potential and real water and air pollutions problems (Gregory 2011; Stickley 2012; Rabe and Borisk 2013; Rahm 2013; Beaver 2014).[1] I aim to compliment this literature by reorienting the study of energy sources in capitalism as more than just centered in geopolitical forces. New forms of capital accumulation strategy are constantly formed and adapted. Within the context of fracking and injection wells, vertical territorialization is a form of such adaptation acted out by humans through the logic of capital accumulation. As socio-natural subjects conduct vertical "space grabs" through the institution of private property because of a culmination of legacies, and in doing so, simply acts within the ideological determinants of capital modes of production.

[1] To form my argument, I work from the well-founded assumptions and research that many who have looked into the impacts of fracking have done already. These assumptions contend that the environmental impacts and the human health impacts of fracking are negative and potentially significant (Beaver 2014; Boggs 2013; Boyer et al. 2012; Drajem, and Efstathiou 2012; Ellsworth 2013; Horwath et at. 2011; King 1993; Kolb 2013; Osborn et al. 2011).

II. FRACKING AND INJECTION WELL BACKGROUND INFORMATION

The combined process of horizontal drilling and hydraulic fracturing provides access to previously inaccessible reserves, reviving petroleum and natural gas development in the United States (Beaver 2014). The newly-attainable reserves were previously impossible or economically inefficient to access because of their location in "tight shale", or shale with low-permeability. The advancement of horizontal fracking technology combined with U.S. interests to become energy independent has fueled an unprecedented boom not seen since the advent of the oil and gas industry.

To begin a commercial fracking operation, a permit for the well is required and consists of between four to seven acres of surface space around the wellhead to serve as the stage bed; essentially this provides a buffer zone and wells require a casing so as not to contaminate underground water tables and aquifers. Groundwater aquifers generally reach about 500 feet below the surface. The vertical drilling of the wells moves through this layer into the hard rock below it and the casing is constructed to protect these aquifers. A bore machine drills vertically into the ground and every couple of feet; a steel casing is placed around the exposed earth. Next, cement is pumped into the casing and on top of it to hold the steel in place and further prevent leakage. Once the casing is in place and the cement is dry, the drilling continues for over a mile until the shale is accessed; in Ohio, this is the Marcellus Shale. The incorporation of horizontal drilling technology happens at this depth allowing significantly greater access to subterranean oil and gas reserves. A vertical well drilled in the Marcellus Shale is exposed to 100 feet of gas-saturated rock. In a horizontal fracking operation, once the desired depth is reached, the drill bit turns and extends the well horizontally, allowing access to over a mile of oil and gas rich rock

instead of just 100 feet (Brady 2013). It takes about a quarter mile and 40 pieces of steel pipe for the well to turn ninety degrees within the earth. Cement is then used to line the well so as to keep the gas from leaking into the surrounding earth (See Figure 2). To access the reserves, the cement and steel need to be perforated by a special gun, which is lowered into the well and sets off a number of explosives extending several feet into the shale and creating several hundred dime-sized holes in the cement and steel lining (Beaver 2014). Next, a mixture of water, chemicals, and sand is pumped into the ground, fracturing the shale and releasing the natural gas that then flows to the top to be captured at the surface of the well. Industry proponents note that horizontal fracking allows for more oil and gas reserves to be accessed with less of a footprint on the surface. The same quantity of gas accessed horizontally would take about 10 to 20 vertical wells to drain. A well can be in production for decades but the initial fracking extracts the most oil and gas and then tapers off significantly as pressure within the rock is released. A significant concern in the process involves the capturing of the natural gas at the surface as spillage is common and horizontal fracking releases significantly more methane that traditional wells (Moore, 2014).

One of the main impacts of the fracking boom is its liquid waste byproduct. The wastewater produced by the fracking operations is released after the oil and gas surfaces and is between 10 and 70 percent of the total water pumped into the ground to access the reserves initially.[2] Between five and seven million gallons of water and sand is used to frack a single

[2] The ODNR reassures the infallible injection well process by leaving no room for error stating "[a]pproximately 98 percent of all brine is safely disposed of by injection back into brine-bearing or depleted oil and gas formations deep below the surface. Nearly two percent is spread for dust and ice control subject to local government approval and requirements" (ODNR 2014). The ODNR maintains that the injection well process is safe and the best option to dispose of the fracking byproduct however, the presentation of the injection well process as failsafe directly contradicts the real events of contamination, leaks, and earthquakes. These show that the stability of the injection well is not infallible even though the state body in charge of natural resources states that it is. They do so in order to continue the fracking

well. The sand and chemicals combined with the pressure of the water helps to fracture the rock and push deeper into the ground. The water that comes back up has been exposed to subterranean rock and compounds that it then carries with it to the surface. About a dozen chemicals make up roughly half of one percent of the liquid contents, some of which are hazardous and while others not. However, many proponents of fracking use the small percentage belonging to chemicals as proof that their impact is negligible (Beaver 2014). One such compound is pyrite, a solid that often contains arsenic. Researchers at the University of Michigan note that the chemicals in fracking fluids may also "mobilize other potentially dangerous elements [within the shale] too: the heavy metals mercury and barium, as well as the naturally occurring radioactive elements radium and uranium" (Moore 2014).

Fracking wastewater is collected in storage containers and transported by bulk transporters to Class II injection wells and processing plants. In Ohio, Class II injection wells are the preferred means of wastewater disposal and often receive waste from neighboring states with different wastewater disposal environments less friendly to injection wells.[3] Injection wells are deeper than fracking wells (typically by a couple thousand feet) but include the same casings to protect groundwater aquifers. Cement is also used to contain the wastewater pumped into the ground in its respective isolated zone in the earth's strata. The regulations around Class II injection wells are most concerned with groundwater contamination and impose limits to the

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activity that is providing much revenue for elites in the industry and politicians with a vested interest in seeing fracking grow.

[3] Injection wells are seen as a safe and efficient mechanism for disposing of wastewater from the fracking industry. The EPA describes class II injection wells a safe disposal practice of industrial waste since the end of World War II. The EPA states, "[a]s chemical manufacturing increased, so did the use of deep injection. Injection was a safe and inexpensive option for the disposal of unwanted and often hazardous industrial byproducts" (EPA 2012).

volume and pressure of wastewater injected into the well. The well is then plugged with cement at the surface (GWP Council 2005, p. 9-10).

Three main criteria must be adequately met for geologic strata to be conducive for liquid waste storage in injection wells. These criteria are porosity (open pores in the rock), permeability (percentage of porous rock), and thickness (connectivity of the rock). The lateral extent of the rock formation is another criteria used to determine the possibility of injection well construction (Wickstrom and Baranoski, 2014). Thick and dense layers that underlay and overlay the strata used for storage are also attractive conditions because this further ensures against the movement of the liquid disposed into other layers of minerals and possible resurfacing. This type of rock layer is called an "aquitard" and must also have low porosity and permeability to act as an effective seal and impede the transmission of the injected waste (Wickstrom and Baranoski, 2014). The less pressure, the more pores and small holes that the liquid waste can seep into when injected into the ground. During horizontal fracking, pressure is elevated when injecting fracking fluid so as to push the oil and gas up to the surface with as much force as possible. During storage of fracking waste, high porosity and permeability is again a positive component but pressure is not. The goal in fracking wastewater storage is to keep the waste underground so it cannot return to the surface or permeate other layers, thereby introducing toxins into groundwater.

III. ON LANDSCAPE

Robert W. Kolb notes that there is a significant difference in type and geography of disturbances from fracking industry activities and previous forms of energy extraction in coal, oil, and gas (Kolb 2013, pp. 122-124). What is entailed in a horizontal fracking operation, how it produces the wastewater as a byproduct, and how that wastewater is disposed of, spans across geographic regions and landscapes, infiltrating populations, every day life, and forcing confrontations between society when before, these activities and their externalities were largely avoided. The transport and the unpredictability of the environmental impacts make it difficult to shield the public from the effects of the fracking operations. This informs how the rural Ohio landscape has been changed and manipulated in the continued use of this landscape for extractive and environmentally hazardous practices in the name of national security and economic stability. Through a critical geographic perspective, one can understand the importance of landscape, visual and embodied, as it affects its residents how they perceive the world in which they live and consequently their relationship to it as separate and divisible from it.

The effects of extractive industries are visible, often leaving infrastructural debris in the form of factories, processing plants, wells, and pits of waste. These changes dot the landscape as reminders of a specific human relationship to the earth dictated by capital modes of production present throughout the history of capitalist nation states. Landscapes of extractive industries are visually and symbolically tied to the arrival of the American nation as a heavy-weight in the international arena. At times, sites of leftover infrastructure are even preserved as historical landmarks and used to attract tourists interested in the heritage of the nation. For example, across Appalachia, coalmines and remnants of company towns are preserved as valuable components of

community history.[4] As relished pieces of historic pride, they speak to the importance of the rural landscape for the development of the nation at the end of the nineteenth and beginning of the twentieth century. The physical landscape of rural Ohio as spotted with preserved and left over remnants of the coal boom and other extractive industries internalizes these memories and visual sensations in community and sense of place. The seemingly indefinite tunnels and caverns in from the coal-mining boom in the nineteenth and early twentieth century as well as wells from the advent of oil and gas extraction in the mid-twentieth century are just some examples of the physical geography of rural Ohio.

Robert Shields offers a useful interpretation of landscape and capital accumulation strategies in his article, *Spatial Questions: Cultural Topologies and Social Spatialization* (2013). He emphasizes the importance of concrete and metaphysical relations to space, both forms of experience being influential in identity formation and in designating and normalizing certain landscapes for certain activities and purposes.

> The nature of places is formed out of the real but intangible relationships between participants in capitalism over time and over distance, intersecting and coming into specific relationships vis-à-vis tangible goods and material processes, all grounded in a particular location. That is, place is a combination of actualizing virtualities such as social and commercial relationships, and realizing abstractions, such as ideologies of planning or representations of particular regions (Shields 2013, pp. 37-38).

[4] There are also company towns that were abandoned as the coal boom waned and disappeared. Today there are museums and tours that one can take in these small towns that preserve this legacy of coal and labor unions. They have rooms filled with artifacts and pictures of the men and children that worked in the mines and they lament the disappearance of the capital that propelled development and boosted the economy in the heyday of the coal industry. This physical landscape is lived and experienced by community residents as a reminder of what was possible with energy extraction. (See Figure 3)

In rural Ohio, this location is spatialised and internalized in the communities and residents of the landscape as a continual folding of temporal activities that incorporate past precedents onto present implementation of new activities under the pressure of future need and imperative. The tangible goods and material processes of rural Ohio are grounded to that specific location because the industries are interested in exploiting the space and its contents, in this case natural gas or shale with the correct porosity. Therefore the combination of historical legacy, national identify, and geologically appropriate characteristics determine rural Ohio as an ideal location for the dumping of wastewater. "[Space] is not locked within one topology… heterogeneous social space must be produced and reproduced as a cultural artifact and performance" (Shields 2006, p. 148). The physical structures and remnants of extractive industries and waste dumping practices combine with a socialization based on capital accumulation by these industries to create a sense of place fixed to a designated and predetermined landscape. Shields also states that spatialisation can be a vehicle of repression for instance in core-periphery dynamics on a global scale or first and third world country distinctions. In Ohio, the spatialisation that takes place between rural and urban landscapes can be understood within this framework of place-making and repression. The conflict over place and identity is not just one of memories but is a battle fought for the right to frame the future for which the present acts. Space is geopolitical. Who has access to green space, resources, community gathering sites, environmental toxicity, protections, etc. are all determined through spatialisation and the variables that interact within its context.[5]

[5] Sörlin (1999) offers a useful anecdote on the importance of memory and heritage as a form of spatialisation. He states, "landscape has provided the raw material for images and projections of territorial entities, be they empires, nations, regions or localities, and these landscapes have been culturally reproduced and mediated" (Sörlin 1999, p 103). The reintroduction of environmentally impactful industries acts to reproduce symbolic landscapes expressed in the physical world. The images of extractive industries are not directly romanticized and adopted as a key component of American national identity, but the rural landscape as an abstract concept cultivates ideology-laden values of liberalism –

Memory is a vital component to identity. In rural Ohio, memory is tied to pride of place and the role that the generations of Americans had is developing the coal industry and the part it played in the growth of the nation and our centers of commerce and politics. Shields contends that place is a memory-bank. For societies, these memories are ritualized and always more embodied than visual hence the memory of previous prosperity in the times of booming coal, oil, and gas exploration and production. Through the reproduction of the landscape and its role in buttressing national identity narratives, capital accumulation is made possible by paving a path of less resistance welcomes to the continued development of extractive and environmentally hazardous industry infrastructures. As a part of the power of entrenched legacies, in the United States, the rural landscape is still conceptualized as the designated sight for specific industrial activities like extraction and dumping because they are correlated to the prosperity of the nation via energy independence. This is changing the economic geography of energy in the region.

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individualism, freedom, and independence. Therefore, the rural landscape of Ohio influences the individual and his experience towards the landscape through the narrative of national pride or as Sörlin describes as an "articulation of territory" similar to Robert Shields' "spatialisation.

PART I: ECONOMIC GEOGRAPHY OF INJECTION WELLS IN OHIO

i. Legacies Of Coal, Oil, and Gas in Ohio

Ohio's relationship to non-renewable energy extraction helps build a complete portrait of the legacy of rural extractive and disposal industries in the current fracking and injection well development. Historical legacies lead into the existence of extractive and environmentally impactful industries in rural areas today and because they influence the continuation of such practices, it is necessary to examine to how economies and lives were shaped around this type of relationship to the earth and the use of non-renewable energy sources in the beginnings of national development as a capitalist state. Particularly, the extraction of coal, oil, and gas directly implicated and facilitated the development and nature of infrastructure, industry, and labor movements. The memory and pride associated with nationalist identity as it is tied to the historical development and contributions of these industries has bled into the present day. The continuation of extractive industries serves a similar purpose, as it has in the past, of buttressing national hegemony and sovereignty while the labor movements have more or less been quelled due to mechanized means of production and decreasing human labor involved in the extraction.

Prior to the coal boom in Ohio, rural areas were largely depopulated and consisted of subsistence farmers (Shifflett 1995, Ch. 2). In 1800 the first coal seam was mined in Ohio: since then, over 3.7 billion tons of coal has been extracted (Crowell 2005). The discovery of coal drew large amounts of investment and created a completely new social and physical landscape. Up until the Great Depression, mining was done in the traditional form of tunnels and mineshafts, involving large amounts of laborers. This form of mining contributed to two social and physical landscape changes: labor unions and the physical infrastructure in the form of towns, mines, transportation, and urbanization. These changes are once physical, social, and economic but most

crucially they reflect a capitalist mode of production that in turn affects the lived experience of the subjects of this labor and landscape. The way people interact with the world around them is heavily influenced by how they labor and relate via their energy and skill as applied to natural substance. In rural Ohio, this interaction gave way to the consolidation of company towns and the development of the labor movement in the United States (Crowell 2005).

Many companies set up company towns near the mines to facilitate the means of production. By locating the workers within walking distance to the mine and restricting activities that might allow workers to be less dependent on the company, the work of mining was made more efficient and therefore abusive of the worker. Company town residents all worked in the coalmines and lived in the same situation of highly structured and regulated labor. They did not own the land or the home in which they lived and they were not guaranteed a wage for their labor. Everything was rented from the company, which gave way to high levels of dependence, and further facilitated the means of production.[6] The coal companies monopolized the purchasing power of their employees and in doing so laid the groundwork for unrest that gave way to the formation of labor movements in the coal industry (Fishback 1992).

In response to the oppressive conditions of coalmines and company towns, labor unions formed to garner better wages and more freedoms. Labor unions in the coal industry began as secret societies outlawed by companies and state governments. Coal unions in Ohio played a major role in the growing strength and eventual institutionalization of unions in the country. The importance of coal production in the formation of the nation is not only seen in the physical

[6] Company policy also prohibited the growing of food in gardens, essentially forcing the worker and his family to purchase everything in the company store while systematically undermining passing on of agricultural knowledge and skills. Purchases were charged to a store credit account that drew from the wages of the workers and if the debt was not paid, high interest rates were applied and effectively enrolled the worker into a cycle of debt in which he had to work for free until paid off (Fishback 1992).

changes to the landscape but also in the transformation and development of organized labor unions which, as Timothy Mitchell argues (2009), is directly related to the development of democracy in the US. Mitchell credits coal for the formation of urban areas because people no longer needed to be close to wooded areas, their source energy in the pre-coal era (402). Quality coal was located in fairly limited areas, including north-central Appalachia. Because of the condensed locations of available coal and the character of the infrastructure to transport and extract coal, "energy now flowed on very narrow channels" (403).

Thus, the workers of the coal industry had a specific kind of political power because they could interrupt the flow of energy in the country as a unified labor force. Coal in the 1800's was the cheapest and most powerful form of energy to power the nation's electricity demands and transportation needs, specifically the steam engine, making the strikes of coal miners extremely effective in achieving the desired changes to their working conditions. Coal was therefore a key commodity to control because a stop in any part of the production chain from extraction to transportation and use would put a serious strain on all capital activities. (Mitchell, 2009)

Mitchell also lends importance the relative autonomy of the coal miner's work as being especially conducive to organizing and the spreading of ideas. Miners worked under relatively little oversight and were required to work in pairs in the mineshafts for safety purposes. The physicality and the autonomous nature of the work facilitated the organizing that occurred in response to exploitation of the laborer. The effectiveness of coal strikes would also lay the groundwork for other sectors of the workforce to make demands and achieve their goals as a unified front against the abuses of capital (405).

The formation of the United States could not have been accomplished in the way it was without Coal. Because it provided the energy needed to build the economy and infrastructure

systems as well as the social formation of labor organizing, coal heavily influenced the character of the democracy we see today in the US. For this reason, energy industries are associated consciously or subconsciously with a nationalistic pride situated in the past and reintroduced in the present and also with economic prosperity situated in the future but asserted in the present tense.

Economically, coal was not only integral to the development of the capitalist economy in the US but also to its global position as an economic and political superpower. The historian Duane Smith (1993) notes that, "Without mining…the United States would not have emerged as a world power by the turn of the century, nor could it have successfully launched its international career". Because of Ohio's plentiful supply of coal, it played a major role in the development of cities and industry at the time and is seen as one of the leading industries in the creation of the physical infrastructure and metaphysical identity of the United States (Buckley 2004). National patriotism and nostalgic pride for America are important narratives tied the capital accumulation strategy of energy industries. For this reason, the intense presence of extractive industries in resource rich areas incorporates these narratives to produce a strong sense of national identity tied to the prosperity of the energy industry as an extension of the prosperity of the capitalist nation.

The physical remnants of company towns, the iconized history of the prosperous coal boom as a part of nation-building, and the beginning of unionized labor still contribute to a strong sense of place and identity in rural Ohio. This identity may be rooted in the plunder of the Earth, but is also related to the physical effects the industry had on the landscape and the social changes that society underwent in response to adapting labor and living conditions. However, the labor involved in extracting coal adapted in the face of powerful labor unions to involve less

human labor and more mechanized extraction techniques, which gave way to a different form of social and physical landscapes.

By the early to mid-twentieth century, most of the coal made accessible through the mineshaft tunnels had been extracted to the best of the abilities of the miners and their machinery. The coal industry also felt pressure from growing competition from the oil and gas industry requiring a decrease in production costs if coal companies were to survive. To adapt, technological advances reduced variability and expense of production by minimizing human involvement. After the Great Depression, traditional forms of underground mining, surface mining, involved less human labor, union demands, and increased potential to develop surface mining technology allowed greater access to coal reserves (Crowell, 2005). These raw materials physically built the nation's cities and infrastructure and further tie the rural identity of "laborer for the nation" to landscape of rural Ohio.

Resulting from technological changes, the early 1900's saw improved efficiency and a rapid increase in production as interstate competition in the coal belt intensified. The country needed coal to facilitate growth. It was cheap to produce and there was plenty of it. This led to a push towards mechanization to avoid a fall in profits for coal while speeding up production. However, World War II provided the coal industry with heavy demand and gave the surplus a place to go in the form of powering factories that manufacture the military arms and tools. Post-WWII, the effects of such heavy and unregulated extraction led to significant concern over the coal-mined landscapes decimated for the war effort. With warring needs no longer legitimating the extraction of coal and its degradation of the earth's surface, there was a significant move towards reversing the negative effects of the extraction.

The environmental movement correlated to the post-war era conscious of the public that was no longer distracted by the threat of global war. Though, coal production continued to soar until the 1960's, the environmental movement was just beginning to gain momentum and eventually made headway in policy and the founding of environmental groups and funds in the 1960's and '70's. In 1963 congress passed the Clean Air Act, then the Wilderness Act in 1964, the Clean Water Act in 1972, and the Safe Drinking Water Act in 1974, all increasing regulation for the non-renewable energy sector (A Fierce Green Fire 2014). The regulations targeted the production, transportation, and aftermath of non-renewable extraction and manufacturing practices thereby challenging profits.[7] The Surface Mining Control and Reclamation Act of 1977 marked the beginning of a conscious and official effort to undo the effects of surface mining during the WWII and to prevent such devastation from reoccurring.[8] Prior to the act, surface mining faced little regulation even though it despoiled landscapes, carving hundreds of feet into the earth to access deeper coal seams (Weber 1985). Today, the impacts of the coal industry on the environment and the economy produce a unique socio-natural relationship mediated by capital that serves as an accumulation strategy for extractive industries.

Most of these policies targeted the coal industry or deforestation practices. By contrast, the natural gas and oil industry experienced a boom during the 1970's due to increased energy demand as coal became less viable of a source because of decreased accessibility and increased regulations. The type of labor involved in extracting and transporting oil was also significantly different from coal. For this reason, organized unions and political power for workers in the oil

[7] The Clean Air and Water Acts are considered a failure in many regards, it did succeed in making certain work around regulations, usually increasing production costs and the price of the non-renewable commodity (Alder et al; 1993, Pederson, 1981).
[8] The act declared reclamation requirements for the coal industry, a process that requires surface mining operations to return the disrupted land to its previous conditions or better (Edgcomb, 1983).

and gas industry declined.[9] Because of this, the oil and gas industry in Ohio has a different timeline of success and failures than that of the coal and its era of prosperity in the late twentieth century contributes to the physical remnants of infrastructure that condition an accepted presence of disposal wells for fracking wastewater (See Figure 3). Oil and gas exploration in Ohio of the 20th century left many abandoned wells and though it was a less invasive and visible form of landscape alteration than that of coal harvesting, the oil and gas industry aided in the fostering of the socio-natural subjectivity.

The Clinton sandstone oil and gas discoveries in Ohio happened as early as 1887 and well drilling to access the oil and gas below began experienced a small boom soon after however, by the 1940s, drilling activity decreased due to the inadequate permeability of the sandstone formation and lack of technology. This left the area speckled with dry holes (abandoned wells) and most believed the heyday of the Clinton sandstone formation and gone. Just ten years later, vertical well fracking began in Ohio and previously "dead" formations, such as the Clinton, were tried again and found successful (Mackenzie 2013; OOGA 2013). The prosperity and productivity lasted three decades, the seventies being extremely successful due to increased production and high prices of oil and gas combined incentive gas pricing, and tax credits for the industry. By 1981, there were over 6,000 wells drilled in Ohio, of which 76 percent belonged to the Clinton sandstone formation. However, in 1986, gas and oil prices fell drastically and most wells in the Clinton were abandoned yet did not curb exploration in Ohio. Ohio drillers took risks, drilling deeper and developing technologies that eventually led to the development and boom of the horizontal fracking industry. Even though many explorations

[9] Timothy Mitchell states that this change in the type of carbon energy produced and used undermined the autonomy of the worker and contributed to consolidated power in the hands of oil and gas executives. This subsequently influenced the face of democracy in the US, as politics was no longer held accountable by public to the extent it was in the era of coal (Mitchell 2009).

proved profitable and produced small booms, the success rate for drilling since 1990 has been less than 50 percent (Mackenzie, 2013).

Oil and gas are fundamentally different from coal in the form of labor and the means of transporting the commodity. The labor is well supervised and more individualistic. Machines play a larger role in the extraction of oil and gas because the reserves lie is humanly inaccessible rock formations thousands of feet into the earth. To transport oil and gas, human agency has been almost completely eliminated. Pipelines are the current form of shipping oil and gas while in the coal era, trains were the main form of moving the energy, allowing for laborers to potentially halt the transportation as a form of strike or protest as they often did. In coal, there were multiple potential nodes of disruption in the chain of production while in oil; the human component is less present and therefore less likely to form any organized labor movement.

Oil and gas played a significantly different role in the formation of heritage, national identity, and community pride mainly because of the form of labor involved and the influence that this formation had on democratic political development as well as the development of capitalism and its subsequent cities and centers of commerce and government built to facilitate capitalist nation-state prosperity via growth. In the narrative of the growth imperative, means of production adapt to become the most efficient possible. As a result, human labor was seen as excess that could be trimmed incrementally as technology improved and replaced human skill with mechanical. In the coal industry, this was also instigated by the increased difficulty at reaching more and more remote reserves. For oil and gas, the type of labor used was less autonomous and involved much more oversight and little interaction among workers. In the fracking and injection well industry, the labor is still highly mechanized, skilled, supervised, and

isolating while also being temporary, on the timeframe of five to ten years during the initial installation and capture of the highest pressure oil and gas from the shale.

Fracking requires a lot of labor power to construct the well and facilitate the initial influx of extraction but as the flow of energy steadies, manual labor needs quickly diminish. The employment boom in the form of the onsite construction of the wells and the manufacturing of parts needed for that construction is extremely temporary, on the scale of about ten years until the demand wanes. This will leave those same areas in a bust period characterized by unemployment and abandoned infrastructure not only in the form of factories and transportation lines but also in the form of dwellings and commerce centers as people leave the area in search of new sources of income. This is the cycle of the addictive economy. It produces experiences of prosperity followed by downturn leaving the site vulnerable and primed for future exploitation from the same sorts of activities. In this way, the rural landscape of Ohio is a geographically pre-determined location for addictive economies and the effects of these economies on the landscape make permanent their future role in the proliferation of extractive industries in rural areas.

Consistent with the hypothesis stating the importance of historical presence to extractive and environmentally impactful industries, today we see these legacies reinvigorated in rural Ohio. We see a renewed, ritualized adaptation of those landscapes, as they are re-enrolled into the production cycle of the energy sector by the boom of the fracking industry. For example, towns that had been abandoned by capital investment after the flight of the steel industry to other parts of the world are seeing a reinvestment in the form of factories and manufacturing plants partly as a result of the heavy presence of fracking (Schwartz 2014). The materials needed for fracking such as steel pipes and cement are also needed for the construction of injection wells to store fracking wastewater. The casings for fracking wells and injection wells are virtually

identical,[10] so much so that many used fracking wells can be repurposed as injection wells. The complete process involved in extracting non-renewable energy in Ohio through fracking therefore necessitates offshoot industrial development and energy infrastructure to propel the extraction forward. These industries then become the consumers of the energy produced to power their facilities that then continue to create the needed materials for the extraction of the energy in the first place.

The relationships between extractive industry, memory, heritage, and how events and experiences are interpreted and referred to during someone's lifetime are intimately related. Rural areas depend on limited diversity in job employment and traditionally, the industries that present themselves in these areas are characterized by raw material extraction, minimal processing, and boom and bust periods. William Freudenburg (1992) assesses extractive industries and understands them as addictive economies in rural landscapes. He notes that the extractive industries and their means of production in the twentieth and twenty-first centuries rely on subjectivities that proliferate the status quo economies in rural areas. Describing these as addictive economies in which rural areas are enrolled into a cycle of dependence, he maintains that the addiction is a characteristic effect of boom and bust industries on the working class populations they employ. It is not a matter of will or determination on the part of the rural individual to become disengaged in the addictive economic cycle. Nor is it an ignorance of the effects of economic activities on the Earth. It is a logical prioritization of survival and

[10] Injection and fracking wells require a casing so as not to contaminate underground water tables and aquifers. Groundwater aquifers generally reach about 500 feet below the surface. The vertical drilling of the wells moves through this layer into the hard rock below it and the casing is constructed to protect these aquifers. A bore machine drills vertically into the ground and every couple of feet; a steel casing is placed around the exposed earth. Next, cement is pumped into the casing and on top of it to hold the steel in place and further prevent leakage. Once the casing is in place and the cement is dry, the drilling continues for over a mile until the shale is accessed (Brady 2013); Injection wells are deeper than fracking wells by a couple thousand feet but include the same casings to protect groundwater aquifers (GWP Council 2005, pp. 9-10).

maintenance of a livelihood within capitalism over a collective sense of tied fates between the Earth and human society. As a consequence, monetary security is the primary means of survival and the involvement of the environment in capitalism as a resource for accumulation reproduces the socio-natural subjectivity that serves the needs of capital accumulation.

Because of their predictable reoccurrence, addictive economies are repetitive and almost ritualistic for the rural areas they take root. This repetition of capitalist modes of production enforces the priority of capital accumulation via the social, economic, and political conditions of society. From an anthropogenic view, repetition as the continual reinvestment by addictive economies can be conceptualized as a ritual within capitalist "culture". Povinelli describes the ritual as "the primary means by which a culture's clock is continually reset, remaking the present in the affective, symbolic, and practical form of the past" (Povinelli 122). The presence of addictive economies is thus a part of a cultural memory. It is continually re-expressed and internalized in a ritualistic manner by environmentally appropriative industries that in turn reproduce the socio-natural subjectivity of capitalism. [11]

The ritualistic nature of addictive economies' presence in rural landscapes acts as a mechanism in conditioning future populations for the reoccurrence of these economies later. The social and physical legacy of extractive industries create a booming economy only to be followed

[11] This socio-natural subjectivity is constantly in flux and in a stage of "becoming" as it adapts and morphs to accommodate ubiquitous and infinite changes to the needs of capital as expressed through its immanent ideology. The ritual serves as a means to integrate the role of the subject as one that the ritual depends upon to continually reoccur. In the ritual there is a cultural imperative to perform as the socio-natural subject - to maintain identity in capitalist society. The continual ritual of re-subjectification compelled through a reinvested interest in rural areas by addictive industries and the individual's desire to perform its role as a socio-natural subject works to remake the capitalist ideology and as a consequence, its subjectivity, that reflects the form of the past socio-natural subject in the present. I will elaborate in Part II.

by a violent and debilitating bust, enrolling the area into a cycle of poverty in the aftermath of failed industries such as coal, oil, and gas (Freudenburg 1992). The weakening of unions provided politicians and capitalist elites to collaborate and profit immensely from continued growth and adaptations while moving in the direction of less accountability to the working masses. In rural Ohio as in other areas of the coal belt, the bust of the coal industry followed by less labor organization induced an economic downturn and consequently an indebtedness to the memory of economic prosperity and democratic involvement while the present situation continued to drift in the opposite direction. Consequently, the prospect of a new wave of investment from the energy industry via fracking gives the area hope for potential economic security whether temporary or long-term.

To facilitate the development and investment by extractive industries that are known to be lucrative in their boom and debilitating in their bust, the state as the law forming and enforcing agency plays a critical role. Without the governance and formalization of property rights, permit regulations, applications, distance requirements etc. the fracking industry as in other extractive industries would not be successful. The state's role and cooperation with the extractive industry works to form an accepted type of exploitation as guarded and approved through the law and therefore, legally in the best interests of the constituents of the politicians and policy makers that form and enforce such decisions. In the following section, I elaborate on the structure of enforcement for environmental regulations and the specifically, the differences between state requirements and regulations pertaining the fracking industry activities in accommodation with its needs.

ii. Federalism and Environmental Policy

An important characteristic of American environmental policy pertains to the structure of governance in the United States characterized by the state and federal dynamic. Cooperative federalism, born out of the push for more federal influence in state governments in the time of the New Deal, is defined as a form of governance where multiple governments are in legislative and administrative cooperative action (Edgcomb 1983). In the US, the application of cooperative federalism is defined by the relationship between autonomous states and the federal government. Within environmental politics and governance, federalism characterizes the differences in which entity, state or federal, enforces, creates, mandates, and finances environmental protection regulations. Unfortunately, dual and often competing forms of governance over the environment induce a lack of accountability for mishaps or hazards (Helland 1998). The necessity that capital continues accumulation consequently requires production strategies to change in order to avoid capital's inherent contradictions. Federalism caters to the development and adaptation these needs of capitalist modes of production, which profits from and in part produced the decentered system of environmental regulations enforcement. In essence, no one can accurately point the finger or take responsibility for environmental degradation because of the complex relationship between federal and state responsibility and varying regulations.

In theory, cooperative federalism describes cooperation between the states and the federal government whereby state autonomy is maintained while regulatory enforcement does not fall through the cracks (Fischman 2005). However, the delegation of authority from the federal level to more localized enforcement, i.e. state level, to county, township, and municipality, has been accused of inducing abdication of the regulations. This occurs as a result of a lack of funds, capacity, or will to enforce the regulations and uphold national standards (Helland 1998). The

metaphor of the telephone game provides a useful means of conceptualizing this problem. A message is formulated by the primary speaker and then repeated down the line and usually as the message is transmitted, it is changed either out of a desire to misrepresent the original message or a misunderstanding between the transmission down the line. The more people it is funneled through, the more it ceases to resemble the original message and the less clear it is who could have misinterpreted the message in the long line of recipients. Federal government regulatory requirements are often mandated to state and officials to be enforced at the state's discretion. Many times this entails further distributing responsibility to uphold federal regulations to smaller and smaller entities within the state.

Peter Pashigan develops another socially-grounded theory of this waning enforcement. He maintains that self-interest and proximity to the ground level effects of industry growth in communities contributes to a local enforcement agencies ability to effectively carry out regulation commitments. When faced with pressures of job growth and dire need for economic relief which is characteristic of areas of addictive economies, local enforcement of environmental regulations has less support and motive to cede to federally mandated regulations if the region would be negatively affected in the form of capital flight (Pashigan 1985).

The impacts of cooperative federalism on environmental policy can be seen in the EPA-administered pollution control laws where the federal government sets standards and state governments implement them at their own discretion. The Clean Air and Water Acts are examples EPA pollution control laws that follow this chain of command. The federal government via the EPA essentially sets a base level for environmental regulations that states can then build on top of and cater to their own needs. The federal government allocates monies to states depending on how well they have taken up and adapted their own regulations using the

federal minimums. State roles in environmental law include tailoring federal standards for their unique situation, establishing compliance strategies, and implementing permit programs (as in Ohio's injection well permit process), and enforce rules (Fischman 2005, p. 189). However, pollution control is only one component of environmental law in which cooperative federalism is central to the framework.[12]

Environmental policy is not only economically oriented but highly political involving many different interest groups with political sway that does not necessarily reflect the importance of the interest groups needs regarding the protection of the environment (Commoner 2014).[13] For example, oil and gas industry lobbyists have considerable political power and push for environmental regulatory policy that undermines conservation efforts. Environmental policy is therefore seen as paradoxical because on the one hand, it serves to protect the environment but on the other, it protects the interests of those who exploit it (Smith 1994). The regulatory exemptions for oil and gas industry practices provide evidence for the internalization of industry interests in environmental policy.[14]

[12] Natural resource law, though less studied in environmental law scholarship, is the other side of environmental law that applies a broader definition of cooperative federalism than that of pollution control (Fischman 2005, p. 189).

[13] Barry Commoner (2014), offers four laws of ecology all of which are pillars of environmentalism today. These include; everything is connected to everything else, everything must go somewhere, the Earth is enclosed, finite unit, and nature knows best. If environmental policy were to simply follow the laws of ecology, it would require that the environment and the earth's resources not be desired or necessary for capital accumulation.

[14] The difference in motive behind pollution control and natural resource law is in pollution control, the interest of civilians is prioritized while in natural resource, there is an effort to find a balance between the desire to extract natural resources and the need to protect the environment. In the case of fracking, both pollution control and natural resource law impact the industry as it produces waste that then needs to be disposed of. However, for the oil and gas industry, environmental law makes exceptions, classifying certain materials and activities under headings that allow for holes in environmental protection. Regarding oversight of enforcement: "Oversight [delegated to the state] is generally less strict than the [federal] legislation suggests because of political considerations and fiscal limitations. This creates a black box of activity to take place so that energy resources can be extracted with the least obstacles and the least monetary cost" (Fischman 2005; Commoner 2014).

Though the 1970s are known as the decade when our most progressive environmental policies came into existence, the exceptions made for the oil and gas industry have proven these policies and regulations hollow when it comes to energy extraction. To start, the Safe Drinking Water Act originally passed in 1974 and amended in 1986 and 1996, is in charge of the Underground Injection Control (UIC) program, which regulates the pumping of industrial and municipal fluid waste underground that may be exposed to and contaminate sources of drinking water. The entire injection well operation, from permitting to closing wells, is covered under this act. In 2004, a controversial EPA report determined that chemicals in the water used for hydraulic fracking "pose little or no threat" to drinking water (EPA 2004). This opened the door for total statutory exemption of fracking wastewater injection from regulation through the UIC program, even though it is the sole regulatory program that monitors and protects drinking water on the federal level. Essentially, fracking chemicals and fluids are exempt in the process of storage or disposal from any sort of oversight or regulation. (42 U.S.C.)

The Clean Water Act was passed in 1972. It excludes the oil and gas industry from the storm water discharge program as long as the runoff from drilling sites or well pads is uncontaminated. The storm water discharge program is meant to control and prevent pollutants from industrial activities, whether manufacturing or farming, from traveling into waterways during storms. To be uncontaminated means to be without exposure or to contain uptake of raw material, byproduct, or waste. Under this act, fracking fluids are not considered pollutants as long as the state determines that the injection or disposal of the wastewater will not affect ground or surface water sources (33 U.S.C.). The definition of fracking fluids as non-pollutants means they are uncontaminated and therefore exempt from the expensive and time-consuming process

of a storm water runoff evaluation and the required infrastructure to prevent such runoff into waterways. This act also speaks to the state autonomy regarding federal regulation implementation and definitions of vague categories like pollutant versus non-pollutant.

The Resource Conservation and Recovery Act (RCRA), passed in 1976, contains a crucial exemption for the oil and gas industry that directly affects the wastewater disposal practices today. Fracking fluid and waste are not classified as hazardous under the act even though they contain chemicals that would normally be classified as such. Instead they are considered "special wastes" (Needleman 1994, p. 1028). This is only possible because of the influence the non-renewable energy industry has on regulatory policy and politics. The classification of fracking wastewater as non-hazardous allows wastewater with hazardous to be disposed of via injection into class II wells instead of class I. Class I injection wells are more tightly regulated than class II. Because congress chose to exempt oil and gas wastes from classification as hazardous, it is easier to dispose of waste from the fracking activities than, for example, the waste from coal extraction. (42 U.S.C.; Associated Press 2013; Rabey 2014; White 2014)

The components involved in developing Ohio as a fracking wastewater hub are diverse and dynamic. They are characterized and normalized through perceptions of values, culture, and politics intimate to capital growth imperatives, which in turn inform the environmental policy-making process (Smith 1992). In Marxist thought culture and beliefs are determined and mediated by a capital-social relation that distances people from their means of production and continues to further alienate the lived experience from its natural origins (Burkett 2009). The manifest political environment and economic interests involved in environmental policy are not void of humanity or agency but they do perform their conscribed roles that serve the needs of an

advanced capitalist economy. The application and creation of environmental policy therefore buttresses the ideology, (culture, beliefs, social paradigms, etc.) needed to protect the powerful interests tied to economic and political elites.

The relation between human society and the environment is transmitted through legacies of experience between capital, humans, and the environment. The political framework of regulation enforcement as seen through cooperative federalism as well as the specific types of economic activities that occurred in the past influence the current situation of intense injection well development in Ohio. However, there is another component to the disproportionate production of wells in Ohio compared to surrounding Marcellus Shale states (See Figure 4), which are also involved in extractive industries with similar economic legacies. By examining the details of the injection well permit processes and environmental policies surrounding the fracking industry, I present a coherent understanding as to why Ohio is the chosen state for regional fracking wastewater disposal.

A positive feedback cycle is present in Ohio's fracking and fracking waste disposal activities. Fracking operations are dependent on the being able to economically store the waste produced which impacts the intensity of injection well construction. The fracking wells and injection wells are related not only in a dependency of the former on the latter but the future possibility of recycling the fracking well as an injection well. Pennsylvania hopes to repurpose abandoned fracking well sites as injection well sites for waste storage from their domestic natural gas production. During fracking, oil and gas in small pores and large reservoirs in the Earth are put under high pressure and pushed out of the Earth. When the oil and gas leaves the Earth it is then under low pressure and contains porous and permeable strata along with a well that already accesses this area in the Earth. It is very efficient to reuse the well in the future as a liquid waste

storage site. Ohio's geology, history, infrastructure, and relaxed permit and regulatory systems in contrast to surrounding states draws a strong wastewater disposal industry needed to facilitate oil and gas exploration via fracking. Ohio is one of the few states in the region with both a strong wastewater injection and fracking infrastructure. It is therefore necessary to discuss the components of the regulatory framework of both waste disposal and fracking operations in rural Ohio, as the two are related and interdependent.

iii. Differences in Marcellus Shale State Regulations

Why has Ohio taken such a central role in wastewater management for fracking in the region instead of surrounding states with equally environmentally abusive histories? Ohio has 202 injection wells while Pennsylvania has 10 and West Virginia has 65 (See Figure 5 and 6). Though an analysis of federal regulatory exemptions for the oil and gas industry and its disposal needs proves helpful in identifying the scope of influence between the federal government and powerful environmentally impactful industries, it does not explain why Ohio specifically has become a regional hub for fracking wastewater (See Figure 5 and 6). Ohio's history with energy extraction lays a solid foundation for the renewed presence of such industries but the present landscape of fracking and waste storage in Ohio is in part because of its relation to surrounding states. The relationship between Ohio, Pennsylvania, and West Virginia's fracking and waste disposal precedents and regulations is crucial. The multiple factors include the regulatory conditions between the states, geological differences, which entity processes well permit applications, and how regulations are determined and then enforced in each state.

The most influential difference between state and federal agencies handling injection well permits is the time it takes for each entity to process the applications. Some states allocate the responsibility of permit allotting to the federal EPA where they deal with many state's private requests for permits. Other states have claimed primacy over this process, drastically shortening the time it takes to receive a reply for your application (Associated Press 2013). The process to get a permit for an injection well in Pennsylvania has to go through the Federal EPA system which can take many months to process while Ohio has what is called "primacy" where the state agency, Ohio Department of Natural Resources (ODNR), holds the sole responsibility of permitting and regulating injection and disposal activities of Class II wells (Kowalski, 2014).

The lack of primacy contributes to Pennsylvania's smaller amount of disposal wells. It takes at the most, 30 days to hear back about an application to build a disposal well in Ohio while in Pennsylvania it can take several months. As a consequence, the amount of applications for permits in Ohio is much larger than in Pennsylvania, and Ohio has accommodated this effective demand for permits by increasing their capacity to build the wells and through policy decisions.

The ODNR forms policy not around the environment but around the economic demands of the energy industry. The Cleveland Business news wrote an article on the prevalence of injection disposal wells in Ohio and sited an interview with the ODNR's overseer of the injection disposal wells, Tom Tomastik stating, "market demand will dictate state policy on the number of wells needed and permitted." He goes on to explain that, "If the development of the Utica Shale play takes off, we will need more to handle what we have here in Ohio too." (McGraw, 2013) The argument that state versus federal agencies issuing permits changes the intensity of the demand for well permits and therefore the quantity of disposal wells constructed partly explains the large discrepancy between Ohio and Pennsylvania.

The history of Pennsylvania's fracking industry matters here. In the advent of fracking in Pennsylvania, the geology of the state helped determine the regional differences in waste handling mechanisms. The fracking boom in Pennsylvania produced a lot of waste, and storing it underground was not an option due to geologic constraints. As a result, Pennsylvania developed a strong recycling component of their waste handling practices, but also violated federal and state environmental protection laws by dumping polluted waste into rivers and streams that fed into local water supplies (Tultz and Bell, 2013; Detrow 2012).[15] Economically the developing

[15] The illegal aspect of Pennsylvania's wastewater management practices recently ran into serious obstacles and has ceased altogether because of a lawsuit. In 2009, Pennsylvania's state treatment plants were accepting municipal sewage and industrial waste from fracking operations and they did not have the

recycling capabilities was logical because transporting waste to other states for disposal is expensive because of fuel, insurance, and higher waste storage rates for foreign waste but Pennsylvania's recycling capacity cannot keep up with the quantity of wastewater it produces. Consequently, in 2011, Pennsylvania Marcellus shale well operators sent 99 percent of its fracking wastewater to Ohio for disposal. (Pupovac, 2012)

The geology of Ohio is generally conducive to storing liquid waste. The Cambrian rock formation beneath most of Ohio serves as an ideal formation for the injection of liquid waste. This formation is ideal for storage of liquid waste because it is fairly deep (2,500-10,000 feet below the surface), is highly porous and permeable, and is also overlain and underlain by thick impermeable layers to protect against the migration of the liquid waste. Ohio also has many abandoned wells from previous oil and gas industry exploration and these wells can serve as a cheap recyclable infrastructure to convert the abandoned wells into injection wells for liquid waste. Ohio is increasingly dominating the waste management component of natural gas production in part because of these physical remnants from previous booms in energy extraction in the form of abandoned wells (Hansen, 1998).

The geology, primacy status, centrality, and transportation infrastructure of a state certainly contribute to explaining why between these three states, Ohio is favored as a liquid fracking waste disposal state. However, there are other contributing factors to Ohio's central role e.g. the specifics of permit requirements and regulations pertaining to injection wells. For example, West Virginia also has primacy regarding Class II injection wells and receives some of

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capacity to remove the pollutants nor store the waste safely. As a result, waste laden with heavy metals and other pollutants was being dumped into rivers. In 2013, the Pennsylvania group Clean Water Action lodged a suit against Waste Treatment Corp. of Warren, Pennsylvania for violating the Clean Water Act, Endangered Species Act, and Pennsylvania's Clean Streams Act. This action stopped the dumping of fracking waste into streams but increased the amount of waste from the fracking industry with no place for disposal in the state (Arnowitt, 2014).

Pennsylvania's fracking wastewater as well but the quantity of wells and volume of wastewater received is minimal compared to Ohio. Therefore a policy and permit requirement comparison between the three states is necessary to add another layer of explanation for this discrepancy.

West Virginia is one of two states that require that landowners and owners of nearby water wells be notified to of the fracking operation (McFeeley 2012, p. 8). In West Virginia the radius of this notification requirement is every landowner within 1,000 feet of a well, for Pennsylvania it is within 3,000 feet, and in Ohio, the requirement is 500 feet from the well bore (State Fracking Laws, 2014; Brannon et al, 2014). Ohio therefore has less public interaction and transparency with fracking and injection wells, allowing companies to dispose without public awareness.

Moreover, both West Virginia and Pennsylvania require the disclosure of chemicals in fracking fluids used in an operation at the well site while Ohio does not. West Virginia is one of five states in the country that require disclosure of fracking fluids before fracking begins at a site (State Fracking Laws, 2014). All workers and local and regional emergency response teams and their employees must be informed of the composition of liquid fracking waste at a site. In Pennsylvania, companies are required to post the contents of the fracking fluids in an online forum called FracFocus.com. In Ohio, fracking fluid content is considered "trade secret" and only the ODNR and medical professionals treating a patient possibly exposed to the chemicals have access to the complete contents of the fluid and are prohibited from sharing that information (Brannon et al; 2012).

The practice of "pooling" differs in each state as well. This component of the fracking industry affects the oil and gas companies significantly and while most states have legislation

regarding mandatory and voluntary pooling, for those that do not extraction and disposal of waste can be very expensive and sometimes impossible.

In West Virginia, pooling does not exist for shallow well drilling which is the type of drilling done in fracking (Wang, 2012). The lack of pooling law gives power to the public allowing for one or two holdouts to completely dismantle a fracking operation because their consent is needed to proceed. Waste disposal wells require the same consent although usually less land is involved because there is no horizontal drilling in disposal wells. In Pennsylvania, voluntary pooling is first attempted among landowners and if consent is not reached, the company can request an integration order with the Department of Environmental Protection (DEP). They must prove that the terms of the operation and integration of landowners are "just and reasonable". The DEP will then notify the parties involved in the integration and hold a public hearing before approving the request. In Ohio, voluntary pooling is attempted first and if mandatory pooling is needed, a fee of $5,000 must be included in the permit application. The companies can therefore avoid state bureaucratic processes and move forward with the operation, whether exploration or injection, more quickly (Brannon et al; 2012).

The initial cost of a well paid to the entity issuing permits differs between the states as well. In West Virginia, though it has primacy and the process for receiving a permit is on the scale of weeks, it costs $10,000 for the first well on a plot and $5,000 for each additional well (Brannon et al 2012, p. 28). In Pennsylvania there are no initial fees just for building a well but the process of receiving a permit can take between three and six months because the process is regulated by the EPA. In Ohio, the cost of a well is based on the size of the population in the township in which the well resides. Before 2010, the cost of a well in a township of fewer than 5,000 people was $500 but today the same fee is applied to a population of fewer than 10,000,

doubling the population while the fee stays stagnant. A well in a township with a population between 10,000 and 15,000 would cost $750 and for over 15,000 people the cost maxes out at $1000 (p. 9-10). Between the three states, Ohio's costs and timescale for well permits are most attractive because most of the wells are located in rural areas with small populations making the cost of a well hardly noticeable to an oil and gas or waste management company (Brannon et al; 2012).

The spacing restrictions of a well in each state also vary drastically. In West Virginia, no well may be located within 3,000 feet of another well (not including water wells) and must be 400 feet from a lease boundary. A well must be at least 250 feet from a water-well or spring used by animals or humans and at least 650 feet from an occupied dwelling including livestock shelter. Also, a well may not be located within 100 feet of a stream, lake, pond, or wetland, 300 feet of a trout stream, or 1,000 feet of a surface or ground water intake for public supply. Pennsylvania's restrictions are similar in that it also requires the well to be at least 500 feet from dwellings and water wells and at least 1000 feet from a water supply. Also, natural bodies of water including streams, rivers, lakes, ponds, and wetlands must be at least 300 feet from the well bore and 100 feet from the edge of the well site. In Ohio, these numbers decrease significantly. A well must not be within 50 feet of a natural occurring body of water, at least 150 feet away from a property line not included in the well unit, 150 feet from an occupied dwelling, 200 feet from an occupied dwelling that is only a part of the unit because of mandatory pooling, and 150 from a dwelling within the unit due to mandatory pooling. Lastly, Ohio requires wells be spaced at least 100 feet from each other and just 50 feet from a public road or railway (Brannon et al; 2012).

Pennsylvania's lack of primacy played a significant role in its lack of injection wells and its geology influenced its development of recycling infrastructure yet its capacity to recycle does not keep up with its production of waste and as a consequence and the excess is exported to Ohio. In West Virginia, the differences in regulation requirements and its lack of pooling legislation have created a somewhat unfriendly environment for oil and gas industry compared to Ohio. Among the three states, Ohio contains the most favorable legal atmosphere for injection well disposal of wastewater and the increase in fracking operations across the country and within the region creates a future need for disposal of the waste produced from the activity. However, the unknown variable is the capacity of the Earth to store the wastewater; the maximum quantity possible to inject into the strata will likely be determined after its effects are irreversible and possibly already realized.

PART II: SOCIO-NATURAL SUBJECT OF INJECTION WELLS

i. Karl Marx and Socio-Natural Subjectivity

The rapid development of injection well infrastructure is the result of a combination of historical legacy, social, and political contexts that offer the least resistance to this needed component of fracking. Yet: why do these legacies exist in the first place? To answer this, I turn to an examination of subjectivity within capital conditioned ideology, an ideology that prioritizes accumulation and asserts a fundamental division between human society reproduction and the reproduction of the natural world.

Within capitalism, the individual as a laborer interacts and relates to the Earth and its substance through the mediation of capital social relations as dictated by labor and capital accumulation imperatives. Karl Marx (1867) explains the separation of humans from their means of production as a vital moment in capitalism that is repeatedly enforced and proliferated. Marx uses the term "metabolism" (Marx 1981, p. 949; Marx 1976, pp. 283, 290) to explain the intimacy and inseparable nature of human fates with the Earth's. The historical legacies, the state and federal regulations, and the physical geography and geology all contribute to the production of injection wells in Ohio. I take Ohio injection well development to demonstrate how the energy industry and the geopolitics context solidify the division between humans and their means of production. In its role as the acting agent, socio-natural subjectivity is a fundamental necessity produced by and aiding in capital accumulation. I contend that labor within capitalism depends on and conditions the division seen manifest in the socio-natural subject, without which, capitalism would not exist.***

Subjectivity determines how we as individuals interpret and experience the world around us and then informs future actions and interpretations through the context of ideology as it is

produced and reproduced by our active involvement in the proliferation of our own subjectivity. It is influenced by the ideology from which it originates and consequently buttresses as the dominant worldview. Socio-natural subjectivity is not a conscious decision made by an individual but it is rationally reintroduced and solidified by the individual and informed by the surrounding context of capital social relations. I argue that an underlying socio-natural subjectivity displaces the human need and means of reproduction on the Earth from the use of the Earth to effectively do so within capitalist society.

Because subjectivity is the result of the interpellation of the individual by ideology (Althusser 1971)[16], which in turn compels the individual to actively reproduce and internalize the subjectivity, the prospect of breaking this cycle becomes bleak at best. To effectively exit socio-natural subjectivity would require the un-enrollment of the individual from the self-reproduction of his own person through the subjectivity of capital while he is still living and depending on capital social formations for survival within society. Louis Althusser explains this tight arrangement between ideology and subjectivity: "[i]n ideology men do indeed express, not the relation between them and their condition of existence, but *the way* they live the relation between them and their conditions of existence: this presupposes both a real relation and an '*imaginary', 'lived*' relation" (Althusser 1969, 233). The real relation in the context of my argument refers to the substances of the Earth, as continuous matter constantly undergoing change, ingestion, digestion, and reproduction, and the fact that humans and their means of production have no *real* division but instead are essentially a part of the same whole in which the perceived separation is *imaginary*. As Althusser notes, the imaginary and lived relations are expressions of the way we

[16] Robbins (2012) describes the role of the socio-natural subject in his analysis of the American lawn. He uses Louis Althusser to understand how individuals undergo interpellation as socio-natural subjects in capital and how this manifests in their treatment of the lawn as a ideologically motivated socio-natural ensemble.

live within this relation to our conditions of existence. The interpretation of our conditions of existence in capitalism is based on the imaginary separation between the material source and us for our reproductive needs, the Earth.

Althusser's understanding of ideology and subjectivity hinges on the subject being *interpellated*, hailed, by an ideology in which he has no choice but to concede and be enrolled. There is no room for potential deviation or a possible undoing of the ideology to which the subject belongs. He writes:

> [the] reproduction of labor power requires not only a reproduction of its skills, but also, at the same time, a reproduction of its submission to the rules of the established order, i.e., a reproduction of submission to the ruling ideology for the workers, and a reproduction of the ability to manipulate the ruling ideology correctly for the agents of exploitation and repression" (Althusser 1971, 132).

Ideology mediates the conditions through which the subject experiences the world by way of this reproduction of submission to the ideology of capital. In the ideology of capital, the socio-natural subject is a crucial to the existence of the subject in capitalism and the reproduction of the laborer. Ideology maintains the normative social relation, constantly framing and conscripting experience and interpretation of the world (Robbins 2012).

To draw the connection between the socio-natural subject and the exploitation of the Earth seen in capitalism, I turn to Karl Marx and his theory on nature and value by way of his concept, metabolism. Marx can help explain the function of ideology as it relates to the constitution of the socio-natural subject. He understood the development of human society as a natural history in which the relationship of the Earth to society can be traced through the history of specific forms of social formations. Marx understands the recycling and reproduction of life

on Earth as a metabolic relationship. Human survival and societal proliferation requires repeated ingestion, digestion, and reproduction akin to an organism's biological processes. This continual process of inputs and outputs is understood through Marx's metabolism as a mode an historical mode of production that is central to any society whether capitalist or not (Marx 1981, p. 949-50). For Marx, the development of capitalist society marks a fundamental break in this continuous relationship between the Earth and humans as a process of mutual need, inputs and outputs in tandem and inseparable. Specifically speaking about agriculture and ecological impacts of capitalism Marx states in Capital Volume I that capitalism "produces conditions that provoke an irreparable rift in the interdependent process of the social metabolism, a metabolism prescribed by the natural laws of life itself (49-50)." He also explains capital production having two outcomes:

> On the one hand it concentrates the historical motive force of society; on the other hand, it disturbs the metabolic interaction be- tween man and the earth, i.e. it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural condition for the lasting fertility of the soil… All progress in capitalist agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress toward ruining the more long-lasting sources of that fertility (Marx 1976, pp. 637–38).

In Capital Volume I, Marx describes the metabolic relationship of man and means of reproduction by specifically he pointing to the centrality of labor in capitalism as mediating

man's relation to nature and in doing so displacing one from the other in the process of reproducing society.

> Labour is, first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature. He confronts the materials of nature as a force of nature. He sets in motion the natural forces, which belong to his own body, his arms, legs, head and hands, in order to appropriate the materials of nature in a form adapted to his own needs. Through this movement he acts upon external nature and changes it, and in this way he simultaneously changes his own nature. . . . It [the labor process] is the universal condition for the metabolic interaction [Stoffwechsel] between man and nature, the everlasting nature-imposed condition of human existence (Marx 1976, pp. 283, 290).

As a consequence, human livelihoods are no longer interpreted in relation to the Earth without mediation by labor. Instead lives are related *directly* to labor and the capacity of man to work to earn a wage and then purchase his means of survival, which ties him *indirectly* to the need to maintain the raw conditions of his reproduction, the Earth. These means of survival are the material forms of the relations between man and nature conditioned by labor in capitalist society. The next question is why and how did labor in capital come to function as the wedge between human and Earth mutually dependent and fundamentally inseparable existence? I contend that there is a more or less decisive moment in the transition to capitalist society that marks how and why this division took place.

Socio-natural subjectivity is constituted and contingent upon the individuals laboring in capitalism which the individual depends upon to provide their own means of production. The

formation of the socio-natural subject necessitated by capital can then be traced to the event of this division by force and coercion in the advent of European industrialism, which spread to the United States during colonial expansion. Rosa Luxembourg calls describes this expansion via colonialism as primitive accumulation where colonized peoples were forcefully separated from their means of production to be enrolled into the labor force as their new means of production and survival either as slaves or wage laborers[17]. From this force and violence humans were enrolled into a relation to nature that disconnected their work and lives from the Earth that sustained them. In effect, humans labored to produce commodities that they did not consume and consume commodities that they did not produce in order to live. To this day, this is a fundamental component of capitalist societies so much so that without this system of labor and reproduction for capital accumulation, there would be no capitalism as a social formation.

A counterargument to the idea of a division between man and the Earth inherent in capital means of production and social relations may be that the exploitation of the Earth by humans has been occurring centuries as humans decimated lands and moved from one area to another to repeat the cycle of use and abandonment of the natural world. Another objection to the generalized nature of my argument is that not all activities and experiences between humans and the natural world today are exploitative. In fact there are "green-technologies" and protests against the exploitation of the Earth by environmentalists. More fundamentally, the ground level intimate relationship that people in the areas exposed to fracking or injection well production have with the Earth as their direct means of survival would appear to work directly against my argument. To counter the first two objections, I present two components of capitalism that

[17] "The capital-relation presupposes a complete separation between the workers and the ownership of the conditions for the realisation of their labour" (Marx 1867, p. 874)

separate it from previous human societal relations to the natural world and help explain the uniqueness of capital social relations as the interact with the Earth as their means of production. In the last objection, I ask, what criteria are used to determine one form of relation to the Earth as more intimate and co-dependent than another? To begin, I examine the exorbitant population growth needed for capital accumulation: population has accelerated the abuse of the Earth as a means to accommodate capital's growth imperative.

The speed at which the world population grew, especially in Europe, during capital's development as the dominant economic form beginning in the seventeenth century was a necessity of capital if wealth accumulation was to continue. Death rates declined in the middle of the seventeenth century which is the empirical, data-based reason for the accelerated population growth, but this was accomplished only through the changes that societal formation underwent in response to the drive associated with profit and continued growth (Li 2009, 1040; Mokyr 1985, 24). Capital desires labor power and as more people become employed, it becomes difficult to maintain a low cost of production of a commodity. For Marx this was known as the reserve labor army. The more people in need of employment to survive, the more competition there is over the jobs that are available and the more willing people are to do a job that others are not willing to put up with. For this reason, employers maintain a strong hold on their workforce and can enforce worse conditions, higher hours, and less pay with little resistance because of the threat that if they become unemployed, someone else is more than willing to perform the work under the conditions and their likelihood of finding another job is extremely low. The reserve labor army, or high unemployment is ideal in for capital accumulation because it allows for the social conditions to keep costs of production low where human labor is needed.

Magdoff and Foster (2011) explain why capitalism necessitates a growing population

and therefore propels the consumption of natural resources at progressively higher rates with little incentive to change consumption patterns or our social relationship to the Earth (30-31). The need for population to grow is one crucial point to make against the Malthusian argument that population growth needs to cease in order to avoid catastrophic climate consequences (Linnér 2003; Robertson 2012). The Malthusian view falls short because it never takes into account what Magdoff and Foster have, that a growing population is needed in capitalist economies and to call for a decrease is calling for a dismantling of capitalism. A growing population provides the possibility of the "reserve labor army" that through a reading of Marx' Magdoff and Foster note is needed to keep wages low (84). Driven by the growth imperative of capital, the rate of consumption of Earth's resources will continue to rise and has done so since its advent. The need to extract value from the Earth without compensation and externalizing the consequences is tied to the socio-natural relationship that humans in capitalist societies are compelled to internalize, becoming socio-natural subjects in the never-ending accumulation strategy of capital.

The second unique characteristic of capital involves the fundamentally different relation to nature that humans have within capitalist society. This relation is internalized through the subjectivation of the individual in capital. The relation is mediated by labor, which is in turn quantified in the money form as an expression of value (Marx 1867, Ch. 1-3). Capitalism only attributes value to nature in so far as it is reducible to the materiality of the labor used to appropriate it (Burkett 1996, 333) that can then be employed by the laborer to reproduce his means of production. This process does not attribute an exchange value to nature, even though the commodity sold for an exchange value expressed by money is the product of a congealment of human labor and nature. The livelihood of the laborer is associated with the state of the

natural world as it operates as a means of production. The self-interpretation of the laborers life by is valorized based in the wage received through a people-nature metabolism of capital labor relations. The survival of human society in capitalism is therefore no longer perceived as one and the same survival of the world society exists in and depends upon. The production of the socio-natural subject solidifies and hardens this concept of parallel trajectories without interference when in fact the intimacy and co-entanglement of their fates is inescapable. In capital, money is the sole means of expression of value and it determines one's ability to reproduce the conditions of survival in capitalism. The unbroken relation of humans and nature is purposefully obscured because without it, labor within capitalism no longer occurs. To achieve an ecologically sustainable and just production system necessitates a successful struggle to overcome capitalism because it is sustained on the basis of the commodity form as the product of labor that adds value to nature through human work (Burkett 1996). Without labor, there would no longer be a social formation of classes and the accumulation and growth needs of capital would no longer drive underlining forces within the elements of human experience. Without the socio-natural subject, capitalism does not exist.

In rural Ohio, it is hard to imagine a form of life and reproduction that does not involve an intimate relationship to the Earth. Whether it is their own private gas well that they use for energy needs or hunting and fishing, this form of societal reproduction is deeply dependent on the health of the environment. In response to this objection to my argument, I clarify my stance in stating that I conceptualize this division between humans and the Earth via labor takes many forms and though some may be more connected physically to the Earth, no one is un-enrolled from the capitalist ideology and inherent socio-natural subjectivity of accumulation. To generalize, one could make the argument, what makes urban interactions with the substances of

the Earth as a means of societal reproduction more distances from the rural interactions with the environment. At the core, neither is solely dependent on the Earth to the extent that when one would prioritize the health of the environment above any pressure of capitalism whether economic or social. They are merely different forms of metabolism of which as the core of both, a socio-natural subject exists and is maintained, nurtured, and reintroduced.

Rural areas are not disconnected from or connected to the Earth to different degrees than urban areas even though there is a tendency to romanticize the relationship rural populations have to nature. This is the same romanticism that many post-colonial studies have attributed to native populations in developing countries or even those in the United States. Native poplations are seen as having a mystically unidentifiable connection to the Earth that the wealthier western societal formations do not. In a sense, implying there is a fundamental difference in the socio-natural relationship of rural versus urban societies lends itself to a fetishized view of the purity and honesty of rural societal relations to the Earth. In these dispersed locations, to say that this socio-natural subjectivity inherent to capital does not exist romanticizes the people and daily lives in each unique context. Despite the assumed connection rural populations have to the Earth, they are still not acting undermine capital. Therefore, the distinction between rural and urban interactions with the natural world in maintaining the former's connection and authenticity and the latters disconnection is not valid. In capitalism, every social formation within its purview is a part of the metabolic relationship as mediated by labor. There is no option to opt out of interpellation into socio-natural subjectivity.

The development of the nation is closely associated with the frontier mentality and the ownership, use, and control over space. The American identity is tied to the notion of the rural

landscape as the heartland of America, the blue-collar hard working individual who succeeds on his own and in doing so propels his nation into the realm of dominance and prosperity (England and Brown 2003). The construction of injection and fracking wells through leased land helps to maintain livelihoods in rural Ohio where diversity in industries is minimal (Tickamyer and Tickamyer 1987, p. 6). The fracking and wastewater disposal well development is an important event that reconstitutes the division between the human and their means of production, the Earth. This is not to say that the workers constructing the well, capturing waste, or disposing of the waste, are connected to the Earth in a way that does not reinforce the socio-natural division of the subject. But, the lessor of the land receiving a profit from an activity he is not a part of, besides through a contracted lease agreement, is enrolled in an extreme form of disconnection that is a function of the development of capitalist economies and their societies today.

The potential wealth and resources to be extracted from the expansion of territory is a known and accepted component of capitalism. From the westward frontier mentality that appropriated the natural world through knowledge production and physical territorial expansion in the name of capital growth to the current fracking boom, the division of space in three-dimensions is driven by the same mentality and ideology expansion into unincorporated space to accommodate parasitic capital growth. In the age of the nation-state, U.S. territory is intimately tied to the success of its capitalist economy because it depends on the energy source of non-renewable energy to power the commodity producing and consuming society we have adopted. Capital requires such expansion to avoid its inherent crises and the territorial expansion into the Earth's strata to access natural gas and find wastewater disposal space is another form of an accumulation strategy facilitated by knowledge production in science and research. Ideologically, this knowledge and the relation between humans and the Earth it proliferates,

serves the need to conceptualize the Earth as subordinate to society and secondary to human needs in capital social relations. This, I argue is fundamental to capital social relations because it is the underlying characteristic of socio-natural subjectivity. The treatment of the Earth as a space of appropriation is an extension of the socio-natural relation between society and the Earth and facilitates capital accumulation while also being its driving force to continually adapt and incorporate new forms of space into means of production.

How do we interpret the role of socio-natural subjectivity today in the development of injection wells in Ohio? To further understand the production and maintenance of socio-natural subjectivity, I point to the institutionalized form of vertical territorial expansion. I further argue that the territorialization of vertical space is a logical progression in the proliferation of the socio-natural relationship in capital and works as a means to secure this relationship through in an institutionalized and normalized form of dominance over the natural world. The legal geography surrounding property rights, royalties, and subterranean strata is simply a particular manifestation of the socio-natural subjectivities agency, self-perpetuation, and survival mechanisms within the capital growth imperative. The state and capital work together to legally facilitate capital accumulation by way of energy extraction but in order to do so, an expansion and clarification of ownership into vertical space is crucial. Delving into the details of the mineral rights and property rights surrounding fracking and injection wells I analyze the legislation surrounding these disputes in Ohio and how this form of juridical power serves to "legally" expand territory in a vertical frontier necessary to continue in the direction of energy independence and capital accumulation on the national and global scale.

ii. The New Frontier: Vertical Space Grabs

Environmental regulations and legislation interact and manipulate space and boundaries and consequently our understandings of territory and ownership. Through out history of the development of the American nation, property and ownership rights remain integral to the foundational values on which it is based.[18] Property ownership in the United State includes the subterranean portion of surface rights, which is fundamentally different from most other countries where subsurface space belongs to the state. In the U.S., conceptualizations of space and its value extend into the vertical dimension as well as horizontal (Cooke 2014). The importance of private property, autonomy, and individuality for capital accumulation especially in the context of neoliberal economics demand a strong legal framework for which to handle disputes over subsurface property rights. The other component of expanding territoriality to vertical dimensions of the Earth requires a production of knowledge about this space, its properties, contents, variables etc. Knowing the geographic location, quantity, and quality of the resources available is crucial to the vertical territorialization of space and only within the context of understanding the contents of the Earth can exploration and extraction of fossil fuels be profitable and efficient.

In the fracking industry, the dimension of the Earth's reserves and its capacity to receive wastewater can only be known through science and research which then legitimates and institutionalizes the territorialization of vertical space within the legal apparatus of the state and

[18] Before settlers even arrived in North America from Europe, much of the land was sold in England. Before setting foot on the continent itself, people had legal claims through money transactions to property in the North American territory, prefixing an affinity for private property in the new colony which predates even further from the voting rights in England belonging to only property owners. (Price 1995, p. 331-343). The Reform Act of 1832 being the event of political modernization in the England. (Phillips and Wetherell 1995)

private property law. To render something known is to claim ownership over it, ownership over its being, its contents, character, and substance. This can be observed in the frenzy not only to understand the seismicity of strata in the Earth, its contents, porosity, density, and depth, but also in the reactionary research on the safety concerns, environmentally hazards, and physical and social effects that such alteration to horizontal and vertical space could potentially have. The production of knowledge on subterranean space is therefore intimately linked to the exploitation of non-renewable reserves that lie within it. The concept of knowledge production and exploration of the Earth in order to claim ownership and envelop it into a productive space for capital accumulation is not new. The westward expansion of the frontier by the colonists coupled the intent to explore and produce knowledge of the unknown with the interest in incorporating that space into the purview and ownership of the colonies by individual ownership and potentially profit. In the same way, profit through fracking can only be realized through the dual-ownership, or at least access and control, of this space through property rights and knowledge production.

During the advent of the nation's formation, the frontier of the United States was oriented around the horizontal spread of territorial claims. In the era of coal mining and oil and gas exploration, the desire to claim ownership over vertical space spurred a new form of expansion into areas uninhabitable by humans but integral to their survival within capitalist society. Today there is unprecedented access to previously unreachable oil and gas reserves, improved technology that expands the purview of human dominion via mapping and geological research, and the greater imperative to push towards energy independence in the face of undependable global energy supplies and hostile geopolitical environments for the United States. Because of these developments and pressures, the expansion into vertical territory is the logical expansion

within capital accumulation. It incorporates more and more space and characteristics of the natural world into the realm of human knowledge and therefore can quantifiably attach value to the space, which has instigated a vertical frontier expansion. The concept of the frontier will be explained further but essentially, the law is scrambling to keep up with new forms of disputes, royalty rights, and property claims regarding the fracking and disposal well industry. So far, it has successfully accommodated this expansion by institutionalizing the frontier expansion as a form of property law.

Fredrick Jackson Turner is known as the founder of the "frontier thesis". Though he focuses on the violent and racist expansion of white settlers west from the eastern coast, he makes a critical argument stating "the existence of an area of free land, its continuous recession, and the advance of American settlement westward, explain American development (Turner 1986, p. 1). A crucial point in his thesis is that land and resources were considered "free" in this expansionary period because there was no formal ownership recognized by the white settlers. Some equate frontier expansion to imperialist practices (Webb 1964). Both forms of territorial expansion are claimed to have aided economic development, accelerating accumulation until the frontier's threshold was met.

Though Turner's frontier thesis is widely recognized as the founding conceptualization of the American frontier in its westward expansion, he is not the only author to have explored this concept and its implications on nation and state formation. As mentioned earlier, the obsession with collecting knowledge over the unknown, the expansive, and indefinite contributes to the increasing ability to claim ownership and dominion over the space and its contents for which knowledge has been assigned. In the advent of the nation, during westward expansion, John Wesley Powell, a distinguished geologist and ethnologist, explored the terrain of the Colorado

River and Grand Canyon and subsequently warned of the economic exploitation of this space. Powell's work is an example of the curiousity and desire to render the unknown known. He quantified and observed the west so as to bring that information into the realm of human knowledge. It is an act of domination, to produce knowledge of something, and domination cannot be separated from frontier expansion. In *Beyond the One Hundredth Meridian* (1992), Wallace Stegner takes up Powell's studies and provides insight into the context of frontier expansion and illuminates a different understanding of the frontier and its importance to nation building.

> The experience of the West is just as inseparable from the central energies of American history… So it cannot safely be dissected out from the national system. And the more you look at it, the more clearly you see that this involvement is complex (Stegner 1953, xvii-xviii).

This statement holds true in the context of today's vertical expansion of territory and knowledge. The experience of *capitalist expansion* is integral to the unfolding and understanding of American history. The national system is the capitalist system and Stegner is correct: they are infinitely complexly entangled with each other.

> You encounter the mercantile-colonial status of the Western economy, the drainage of Western wealth eastward, the compensatory process of federal benefactions, preferential freight rates, and a myriad of concrete facts related to these – all national in implication. [Look at any commodity produced there] and you bring in the tariff, absentee ownership of the West, Eastern control of Western finance, and the stockgrowing portion of Western Agriculture. And if you will look at [this commodity] just a little longer it will lead you straight to the basic conditions of the West (Stegner 1953, xviii).

Stegner emphasizes the embedded of nature of the western state with capital by way of facilitating the production and sale of commodities for capital gains. He notes the importance of cooperation between government policies and capital accumulation in the form of federal benefactions and preferential freight rates. This legal and economic relationship to the expansion of ownership over horizontal space is intimately national in orientation and purpose.

The experience of *capitalist expansion* is integral to the unfolding and understanding of US history. The national system is the capitalist system and Stegner is correct: they are infinitely complexly entangled with each other. He emphasizes the embedded of nature of the western state with capital by way of facilitating the production and sale of commodities for capital gains. Cooperation between government policies and capital accumulation in the form of federal benefactions and preferential freight rates was a significant benefit to expanding extraction industries as well. This legal and economic relationship to the expansion of ownership over horizontal space is intimately national in orientation and purpose.

The literature surrounding the frontier thesis today understands the epoch of frontier expansion in the US territory as finished; the only frontier expansions occurring today are seen in the developing world (Barbier 2005, p. 287). Today, the vertical frontier, though not colonized as the horizontal space of North America, involves competition driven an economic incentive analogous to the frontiers described by Turner. With this expansion requires and necessitates a form of knowledge production to render the unknown as intelligible and representable.[19] Claims over subterranean space today are made for similar reasons as the claims for land and resources in the era of western frontier expansion. Like westward frontier expansion, it spurs and requires a

[19] See Martin Heidegger *Age of the World Picture* (1977) for a discussion on the role of scientific knowledge and research as a means to put the world in front of man as an object to be represented. This need to calculate the world, Heidegger argues, is innate to the western metaphysics we are caught up in today (Heidegger 1977, p. 115-136).

similar focus on scientific study of the space and its properties. The westward expansion of the frontier drew support from academic institutions and history societies such as Illinois Normal University and the Smithsonian Institute (Stegner 1953, p. 6). The recent fracking industry growth demands a systematic and institutionalized form of knowledge production with specialized majors and degrees in geology, petroleum geology, geophysics, petroleum engineering and so forth.

The recent fracking industry growth demands a system of knowledge production and legislation to determine ownership rights. The profit incentive significantly influences the livelihoods of fairly poor regions, which only raises the stakes and instigates competition over claims. Therefore the state, as a hegemonic governing body, facilitates industry growth by way of institutionalizing a legal framework defining ownership but also ideologically, reinforcing the subordination of the Earth to the needs of capital growth.

From the discussion of nation building through space and knowledge expansion, the interest in legalizing and institutionalizing the process of claiming ownership and royalty rights over vertical space relates can be seen in the context of capital accumulation as a means to achieve an ideological imperative of power and dominance.[20] If we understand territory in the

[20] To discuss the theoretical and ideological relation to vertical space and dominance, I employ a reading of Eyal Weizman's book, *Hallow Land* (2007), as he lays the conceptual groundwork for how to consider vertical space as a means to exercise power. Weizman argues that the ownership vertical space can be a strong source of power and influence. In *Hallow Land,* Weizman notes several examples of how important vertical space is to effectively exercising of control by Israelis over Palestinians. Weizman's focus on the Israeli-Palestinian conflict highlights the centrality of the control over space and specifically vertical space as a means to accumulate power and legitimacy both economically and militaristically. Israeli forces employ a territoriality through three-dimensions constructing walls, tunnels, and other innovative forms of barriers and boundary making. The infrastructural feat of Israel in constructing a new topography of tunnels and bridges underlines the power of vertical space in being able to achieve an end goal, whether security, discrimination, or capital accumulation. The systematic control, domination, and manipulation of vertical space by the Israelis is an example of the entanglement of knowledge production and the nation-state's need to secure hegemony and legitimacy by way of hyper-defense and territorialization. Weizman's explanation of the power that vertical space control and ownership can

traditional horizontal sense as occupied by bodies and under the control of a governing body that can act to maintain the territories boundaries, regulating what goes in and what goes out, then the subterranean is an extra-territorial space. The vertical space needed for fracking and injection wells is non-human, uninhabited, and has no potential to be a space of human life literally. For this reason, the subterranean is not subject to the same rules and law as surface space but the concept of private property is consistent throughout all dimensions of ownership. What remains different is the capacity for society to understand the real limits of vertical space and its physical ability to undergo manipulation and stress. It is conceptualized as an infinite frontier, which is a welcome mode of thinking for capital accumulation. The unknown in the knowledge production surrounding the capacity of the Earth to handle manipulation does not contribute to any meaningful environmental policy measures that anticipate even an arbitrary limit. The concern for the environment and the communities of rural Ohio therefore involves this conceptualization of subterranean space as an infinite pit without physical limitations.

Another fundamentally problematic difference between vertical and horizontal property rights is the possibility of multiple, communal, and sometimes unknown or unaware owners of mineral rights. This is a huge burden on the oil and gas companies interested in extracting resources because they have to spend resources to find these owners in order to form a lease agreement and extract oil and gas. In response to a real need to easily access and determine owners, mineral rights law has been revisited and in some states revised to facilitate consolidation of surface and mineral rights ownership.

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exercise over the manipulation of social and political life informs how to understand the layers of interests involved in the fracking industry from national, state, local, and individual, and why there is so much at stake in desire to territorialize the subsurface.

However, there is no universal form of mineral rights law making it difficult for national companies to have a uniform understanding and protocol for contacting owners and arranging lease contracts. Each state, just as it has its own surface property and realty laws, determines its own mineral rights laws as well. Though some states have adjusted mineral rights to adapt to the fracking industry needs, not all have been able to, creating complexity surrounding mineral and surface rights that exposes the lack of comprehensive legislation on ownership of vertical space.

In Ohio, the history of mineral rights law can help explain how subsurface ownership was initially severed from surface land ownership. The vertical expansion of property began in the 1800's. The discovery of oil and gas within the Earth's surface provided landowners with the possibility of making a profit from the sale and leasing of mineral rights while they retained their surface ownership. Today mineral rights law is complicated and often contested because the ownership of the land below a property may not be known and may be shared among multiple owners within the same strata or from layer to layer. In Ohio there is highly heterogeneous ownership of strata and minerals beneath homogenous surface rights.[21] This causes problems when booms of extractive industries provide a renewed interest in the subsurface minerals requiring access those minerals and their owners to continue profit accumulation. In the current fracking boom, the division of vertical space below the Earth's surface has created expansive legal doctrine and powerful means of land appropriation for oil and gas companies and interests. These lease agreements not only allow the leasing of the land for resource extraction but also usually include clauses that allow for a secondary purpose of the subterranean space if minerals are not found, wastewater injection wells.

[21] "Millions of acres of land in this country are owned by persons who do not hold title to the underlying minerals." (Dycus 1980, p. 871); "Most valuable minerals in the US are owned separately from the land which overlies them." (Huffman 1982, p. 201, 202)

The Ohio Dormant Minerals Act, first enacted in 1989, states if the owner of the mineral rights was not the landowner, and the mineral rights owner had not explored or extracted any of the minerals from the sub-surface in 20 years, those mineral rights below the landowner's property would automatically be transferred to the landowner. Before the amended version, no notice to the previous mineral rights owner was required for the minerals to be classified as abandoned and transferred to the current holder of the surface area above.[22] However, many times the mineral rights are severed from the surface owner and under Ohio law, the surface owner has virtually no ability to stop a fracking or injection well operation if a well permit as already been allocated. In effect, even though the surface land may be drastically changed in the process of developing the well and the needed infrastructure surrounding it, the surface landowner has no ability to appeal the well permit.[23] Another aspect of the litigation surrounding oil and gas in the age of fracking is the forced pooling legislation. As mentioned prior, in Ohio,

[22] The amended version of the Ohio Dormant Minerals Act requires a notice given to the absentee owner of the intent to declare mineral interests "abandoned". The notification to the current owner of the mineral interests includes the names of each holder of the mineral rights (there may be many because of shared ownership or the splitting of different layers "horizons" of the subterranean space), and proof that in the last 20 years preceding the date of the notice no action that would preserve the mineral interest has occurred. The notice must be sent by certified mail to the last known address of the owner(s) and if the address is unknown, the landowner must publish the notice in each newspaper in the county that the mineral interest resides (Ohio Dormant Minerals Act 2006); The holder of the mineral interest must take action to preserve their mineral rights if they intend to maintain them or else the mineral interest will be declared abandoned and then the landowner will possess them. The mineral interest owner has 60 days from the date of the receipt of the intent from the landowner to take action in the form of an affidavit to preserve the mineral interest. The owner of the interest must include a description of the mineral interest and a declaration of their intent to preserve it. All means to prevent the abandonment of the mineral interest includes the proof that an event has occurred during the 20 years preceding the notice of the landowner. This event could be that the mineral interest was the subject of a title transaction, production or withdrawal of the mineral interests, the subterranean space has been used for underground gas storage, the mineral interest owner was issued a mining or drilling permit, an affidavit to preserve the mineral interests has been filed, or a separately listed tax parcel number has been created for the mineral interest. If the mineral interest is in coal or interests connected to coal, the mineral interest is held by the federal or state government, or one of the previous listed events has occurred in the last 20 years, the mineral interest cannot be declared abandoned. In essence, if a landowner files a notice of intent to declare the mineral interests abandoned, and the mineral interest owner replies, the mineral interest is not declared abandoned and stays with the current owner (Hall and Daniels 2008).

[23] No. 2012-1207, 2013 WL 363411, at *1 (Ohio 2013)

included in the application for a fracking or injection well is a choice to pay $5000 to enable forced pooling. This allows the oil and gas developer to force a parcel of land into a drilling unit if the majority of parcel owners in the unit are in agreement to lease their land to the developer. If the surface owner also owns the mineral rights of his land but is in the minority opposing the exploration of his mineral resources, he is forced into the pooling unit and will receive royalty payments as with the other owners in the unit. However, he will not receive a bonus payment as the others who were not "forced" into the unit (Hall 2008). The mandatory pooling legislation incentivizes owners of land and mineral interests acquiesce to the gas developer because of the possibility that the developer will "buy" a mandatory pooling function and those who resisted will receive less compensation than those who entered into the lease without force pooling.[24] Without such legislation to determine mineral interest rights and owners, oil and gas companies have to communicate with multiple owners of mineral interests in disparate places with different levels of interest in the subsurface rights. The process of securing a lease could then take an exorbitantly long time. (Brady and Crannell 2012, p. 17)

Once a mineral interest owner enters in to a fracking lease, the way the lease is written allows for the lease to stay in effect for an unknown time period. This is defined by two terms of the lease. The primary term determines the time period in which the company needs to have drilled an exploratory well and is usually on the scale of two to five years (Little 2008, p. 2). This term is usually negotiable because both the lessor and the lessee have stakes in exploring the reserves. The longer the primary term is, the longer the lessor waits to receive royalty payments

[24] However, the law of forced pooling is only applicable if the surface owner also owns the mineral rights since the lease is tied to the subsurface rights, not the surface. As a consequence the surface landowner who does not own the mineral rights has no say in whether an oil and gas company uses the surface land to explore the mineral interests below. The landowner in this case will also not receive royalty payments though they are protected from "unreasonable damage" of the surface land of the lease (Brady and Crannell 2012, p. 17).

from a producing natural gas well and the longer a company pays a "delay rental" that the owner receives from the developer on an annual basis until the well is producing in paying quantities. However, the delay rental payments can be used to keep a non-producing well lease in effect. Sometimes, as long as the owner is cashing checks from the company, they are acknowledging the continuation of the lease agreement (Little 2008, p. 3).

Once the well is drilled and is producing, the second term commences and is the longer lasting of the two terms. This term is longer because most leases will allow a developer to maintain the lease, producing or not, due to the term "paying quantities" (Little 2008, p. 2). Paying quantities refers to any form in which the oil and gas developer is using the land. As long as the lease is producing "paying quantities" it can legally not be broken. The developer has an interest in holding onto the right to that space because it already invested in it through the lease and the payments to the mineral interest owners and needs to make a profit off of that investment. Because of the potential for the lease to be unproductive, development firms use vague terms in the lease so that legally, the lease can be for multiple uses of the land including the development of a pipeline, injection well, or treatment plant if the exploration for oil and gas proves unproductive (Watson 2012).

The right to use the land and subsurface space for storage and disposal of wastewater is often slipped into a lease agreement to cover the interests of the developer in case there are no viable resources to be accessed (Little 2008, p. 2). For example, if a well is unproductive, to ensure that the investment by the developer is not completely wasted, a disposal or storage well can be constructed instead and provide the developer with some profit and the lessors with royalties. The intention of the mineral rights owner is to profit from the resources extracted, not the permanent use of the space as a waste disposal or treatment site. However, because the terms

of a lease require that the developer be *using* the space leased, if an injection well is within the leased space, the lease will never end because the injection well is always serving an active purpose of wastewater disposal. For this reason this use of the vertical space essentially renders the lease permanent because it will always be in use as long as the disposal well is in existence because it is permanently storing the wastewater (Little 2008, p. 2).

The interest in vertical space in Ohio for the development of gas produces an anxiety surrounding the legal ownership to the different strata within the Earth that do not necessarily belong to the landowner of the surface. The current scramble to claim ownership over vertical space is reminiscent of the initial territorial expansion of the nation through the development of the frontier and the claims of ownership as people moved further west. The parallel goes further in similarity between the underlying motive to explore natural gas and oil reserves today and the motive to expand the nation's frontier. Both activities are in service to the proliferation, development, and maintenance of the hegemony of the US. Horizontal expansion of the US territory between the seventeenth and nineteenth centuries advanced the burgeoning nation as a power recognized both economically and politically as its territory expanded and more resources were enveloped into its purview with each extension of the frontier.

CONCLUSION

The physical, historical, legal, and social legacies contribute to Ohio's role as the dumping ground for fracking wastewater. However, these conditions involved human actors and agents within capitalist society and to understand the more or less collective role in developing injection well infrastructure in Ohio as compared to other states required a theory of the metaphysics, the sub-conscious, and the ideology behind the human maneuvers and adaptations for capital accumulation. Socio-natural subjectivity posits a relation between the subject of capital and the natural world from which society consumes to proliferate. Socio-natural subjectivity is characterized by mediation between humans and their means of production, the Earth. This continues to entrench itself in life and becomes, through labor, the way in which we relate to the Earth. As a consequence, the use of the materials of the earth whether non-renewable resources or physical space for waste storage is understood in terms of capital profits instead of the expense it puts on the natural world most effected. There is a dissonance between societal reproduction and the health of the Earth.

The manipulation of the landscape in terms of transportation, industrialization, urbanization, and physical alterations by the coal, oil, and gas industries in Ohio contributes to the continued ritual of addictive economies in the area (Freudenberg 1992). Fracking and injection well industries are the present day form of the addictive economies entering into their boom stage in Ohio. In this way the rural Ohio landscape is fallowed for the renewed use by such industries that tend to exploit the earth. This exploitation however, is only possible through the coordinated efforts of policy and legislation. In Ohio, the cooperation between capital and the state institutionalized and therefore legitimized this form of exploitation under the umbrella of the legal system and a façade of tightly bureaucratic regulations and enforcement mechanisms.

The mineral rights laws, primacy versus non-primacy, and differences in spatial and monetary regulations for injection and fracking wells among the Marcellus shale states demonstrates how purposefully unequal the atmosphere across space is for the development of fracking injection well infrastructure. From this comparison and historical analysis, I conclude that Ohio has been systematically pre-determined by capital accumulation strategies driven by profit motives to be the dumping ground for fracking wastewater from the Marcellus region.

The economic geography analysis is supported and enriched by a theory of socio-natural subjectivity within capitalist society. Marx understands the fundamental relations between humans and the Earth throughout time as a natural history where the metabolism of the matter and substances on the planet including human society takes on an organismal character of ingestion, digestion, and reproduction. He contends that under capitalism, this metabolism is altered to include labor, which is the result of the development of a value form – a system of this valuation by money (Marx 1867, Ch. 1-3). The socio-natural subject is thus the subconscious interpretation of the world around us as we are a part of capitalist society. The socio-natural subject is interpellated by capital oriented ideology with timeless priority of accumulation to infinite ends over life itself (Althusser 1968). One only needs to look at the inequality within countries and across the continents to understand that the capital-social formation exists in tandem with suffering and violence on the part of this ideological imperative.

Where do we see the continuation of socio-natural subjectivity in the fracking and injection well industry? In the past, socio-natural subjectivity took the form of horizontal expansion westward to industrialism and urbanization facilitated by the exploitation of coal reserves. Today, socio-natural relations as examined in the fracking and injection well industries are characterized by a reuptake of territorial expansion but in the vertical realm. The calculation

and research of the subterranean is a field of study almost solely tied to the non-renewable energy industry and therefore serves as a territorial claim on the grounds of knowledge production and representation. Physically, the legal framework of mineral rights interests and determining ownership or control over this space is highly politicized and contentious. The material vertical expansion of territory has changed the conception of how natural is valued to include not only the minerals within a space but the physical space itself and its capacity to store waste.

Vertical territorial expansion has ideological roots in the frontier expansion westward in the beginning of the American nation and subsequently, national identity narratives are tightly aligned with this movement and rendering intelligible the unknown horizontal space. Today, the fracking and injection well industries serve a similar purpose of aiding American geopolitical power and sovereignty on a global scale by producing knowledge and quantifying the space of the Earth's strata specifically for the purpose of extracting natural gas and oil which in turn, facilitates the stabilization of US energy independence.

Thus, following the theory of socio-natural subjectivity, the actions of individuals in capitalist society serve to perpetuate their continued interpelllation by capitalist ideology and only through this action does capitalist society continue to be the dominant form of social organization and societal reproduction. Non-renewable energy extraction is a manifestation of a socio-natural subjectivity. The resources are integral to the continuation of industrialized capitalist economies and the production of commodities for consumption and in this way, the interpellation of the subject into a socio-natural relationship with the Earth is inevitable and unavoidable. This progression is characterized by the territorialization of the earth in the vertical dimension so as to appropriate its space and resources for capital profit. Capital accumulation is imperative to such societies and socio-natural

subjectivity facilitates its needed continual adaptations in strategy and means of production. Today, this adaptation can be seen in a form of vertical territorialization materially and metaphysically by the rendering this space intelligible and representable through scientific knowledge in service to capital accumulation. Through conceptualizing the earth as a commodity to be owned, controlled, territorialized, and exploited, socio-natural subjectivity is renewed and proven to be powerful in its own proliferation. The development of injection wells in Ohio is thus just one example of the continuation of socio-natural relations in capitalist society as they produce the economic geographies and legacies and condition the realm of possibilities for the future use of space as an accumulation strategy.

APPENDIX: Giorgio Agamben and bare life

To understand how communities and individuals are socio-natural is to understand how their character as socio-natural performs in the accumulation strategy of energy extraction by way of social conditioning through societal norms and expectations. Giorgio Agamben's concept of citizenship clarifies these forces acting to produce and secure socio-natural subjectivity as a normative component to the ideology of capital. Agamben's essay, *What is a Distituent Power?* (2014), details "bare life" stating it is constituted through an apparatus of exception. I do not repeat the traditional interpretation of bare life in my analysis. Instead, I examine bare life as a concept to be applied to the role of the citizen, the socio-natural subject, of rural Ohio.

In his explanation of bare life Agamben conceptualizes it as the politicized being produced by the event of division and separation from its form. He states that life only becomes political when the "structure of an exception" or an apparatus of exception divides and captures life; rendering it to its new form, bare life (2014, p. 66). The subjectivity constituted through the individual as bare life determines the individual politically qualified. "Politically qualified" denotes to be able to participate in society as implicit to the social relations of capitalism ranging from voting, laboring, paying taxes, and so on. To contextualize bare life in rural Ohio's fracking and injection well development, the socio-natural subject of rural Ohio can be seen as included by way of its exclusion. The subject is excluded from protection and privileged security against the consequences of capital exploitation – health hazards, environmental degradation, and economic instability – but in this exclusion, the subject is included because of its role in performing a needed function as the laborer, the care taker, the reproducer, of the space of capital exploitation.

Bare life results from the continual alienation and produces the socio-natural subject of capitalism. The ritualized nature of addictive economies, constantly reoccurring and then uprooting and redefining the conditions of life for the socio-natural subject, fulfills the bare life requirement needed to accommodate capital's means of production. Without the constitution of bare life, the individual would not function as a citizen or a socio-natural subject of capitalism.

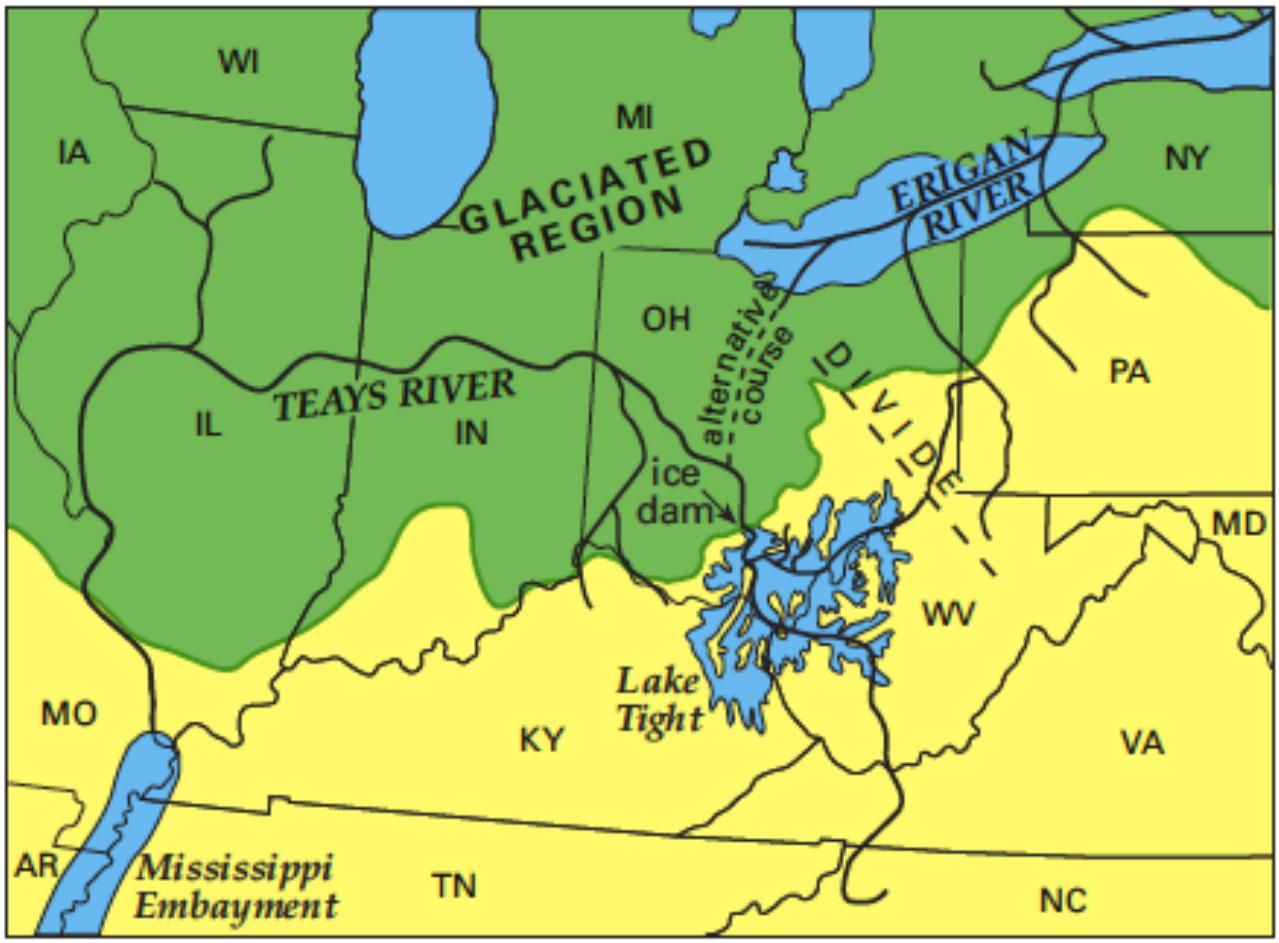
As explained earlier through Marx's "metabolism", an essential component of capitalism is the displacement of the laborer from the means of production, the disconnection of human livelihood from its source of sustenance – the Earth. Therefore, the citizen in the form of bare life performs the role of the laborer and contributes labor power crucial for the proliferation of capitalism. The socio-natural subject, as it is constituted through the apparatus of exception, is the manifestation of this break between of human and natural life resulting from acts of labor in capitalism. The socio-natural subject as bare life occupies this space of the break between humans and the natural world – natural life and the politically qualified life. In the fracking and injection well industries, their presence and role in the communities they are located is in part facilitated and allowed by the socio-natural subject acting within the politics of which they are politically qualified. The emphasis on political qualification stems from the moment when life, as inherently not political, becomes political when undergoing exclusion through the apparatus of exception and then inclusion by way of its necessary exclusion. It is only through the deactivation of the apparatus of exclusion that Agamben declares we can conceptualize another dimension of life, a transcendent and outside form in which humans and nature are not separate entities mediated by labor.

Labor as it is performed by bare life, is political as it informs the self-identification of the socio-natural subject within capitalism. The specificity of social identity as it pertains to a state

or nation today corresponds to a predetermined role of a socio-natural subject determined by historical, economic, social, and geographic legacies. Agamben emphasizes the importance of the state in enforcing the socio-natural relationship within the concurrent subject by way of attaching state sovereignty to social identity. The US typifies this attachment in which the components are co-dependent. This dependency is hinged on the expectation that citizens will *behave* as citizens. To do so is to perform and act accordingly within a capitalist social-relation that facilitates accumulation and growth. In rural Ohio, this denotes a citizen bound to a socio-natural subjectivity that compels them to act to accomplish the desired goals of the state power. As seen through this analysis of historically present extractive industries, the state and capital work in tandem to accomplish a mutual goal of power (sovereignty, independence, etc.) by way of capital accumulation. State power is integrated into capital accumulation, which is conditional on non-renewable energy production to power the society - factories, homes, infrastructure, etc. - that is needed to continue the capital accumulation. The politically qualified bare life, the socio-natural subject of rural Ohio, therefore behaves as a citizen of the state-capital alliance through its systematic inclusion by way of its exclusion that buttresses the capital-social order.

FIGURES

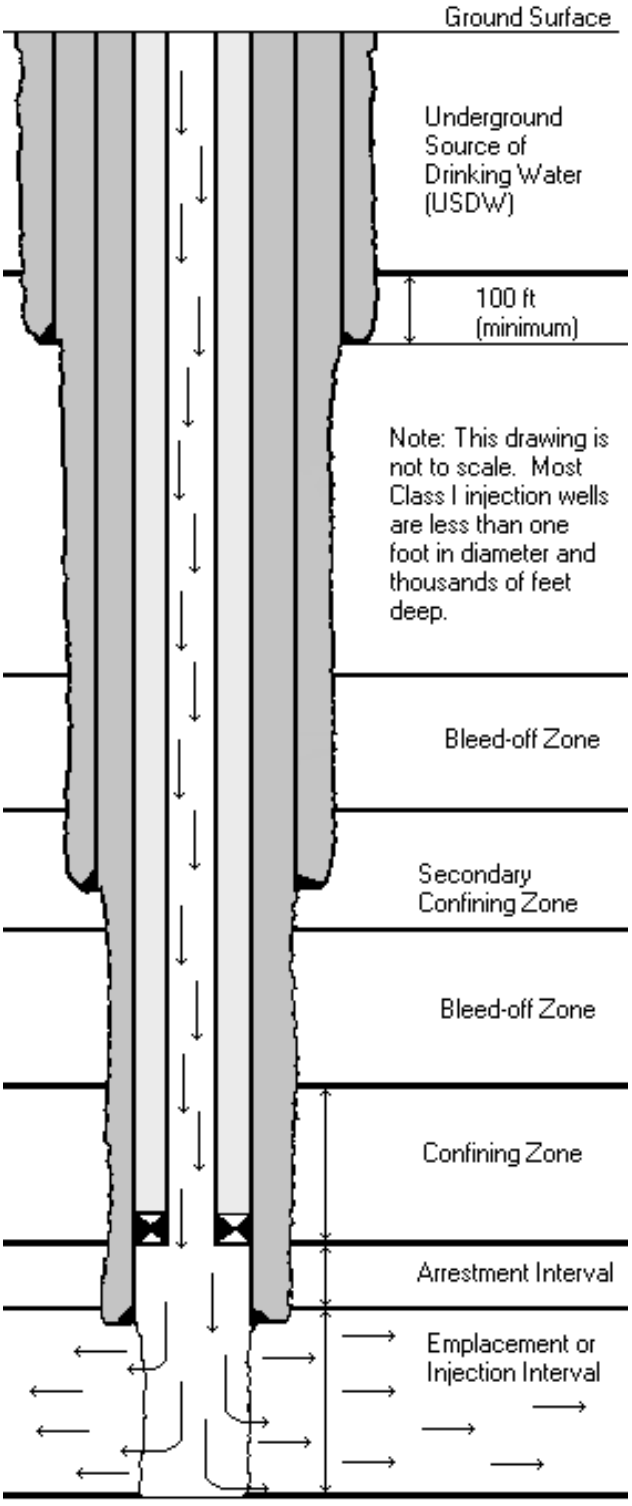
Figure 1: Glaciated and Un-glaciated Regions in Ohio



Preglacial Teays River in north-central U.S.

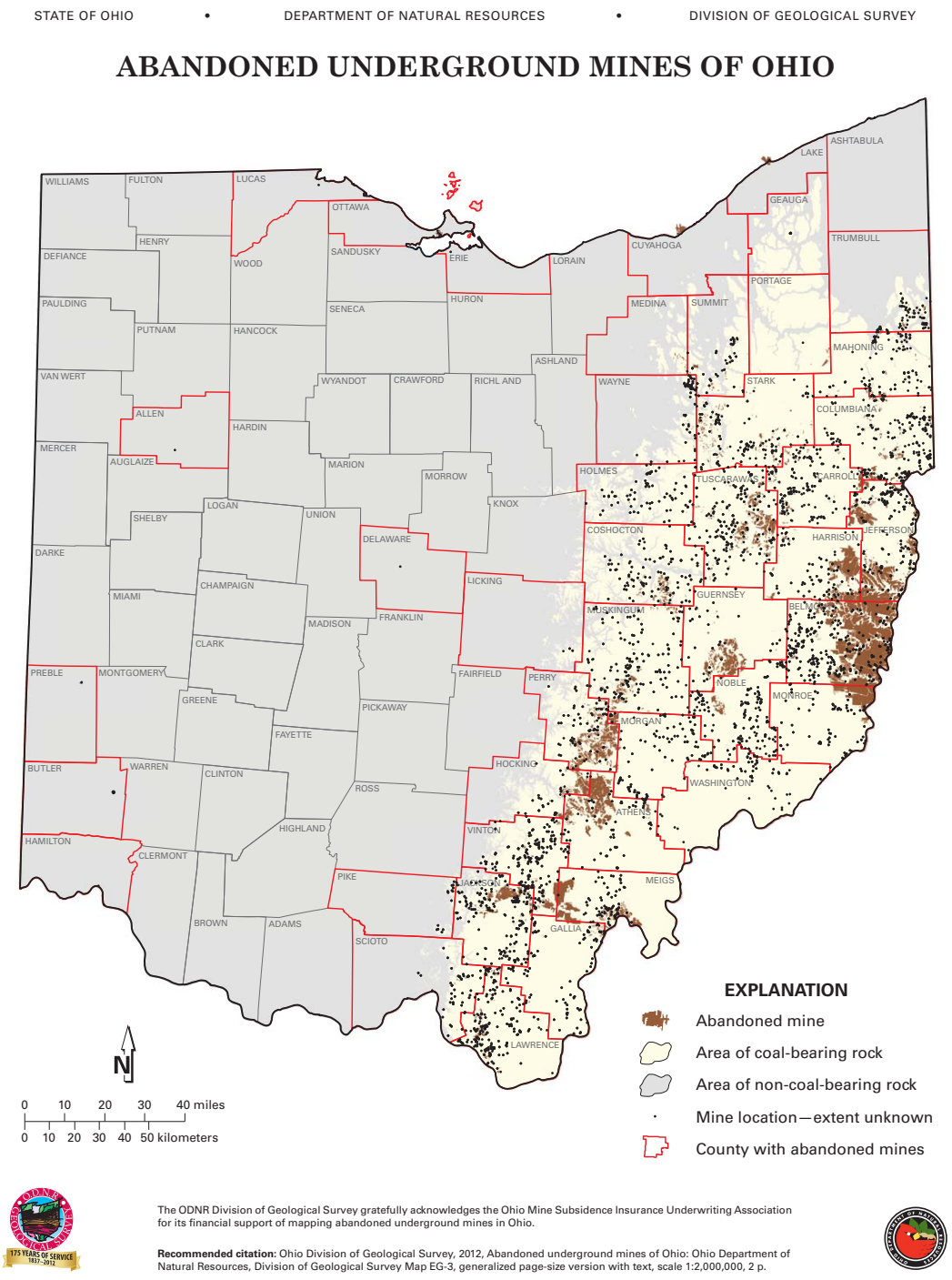
Hansen, Michael C. *The Ice Age in Ohio*. Columbus, Ohio: Ohio Department of Natural Resources, 2008. Educational Leaflet No. 7.

Figure 2: Injection Well



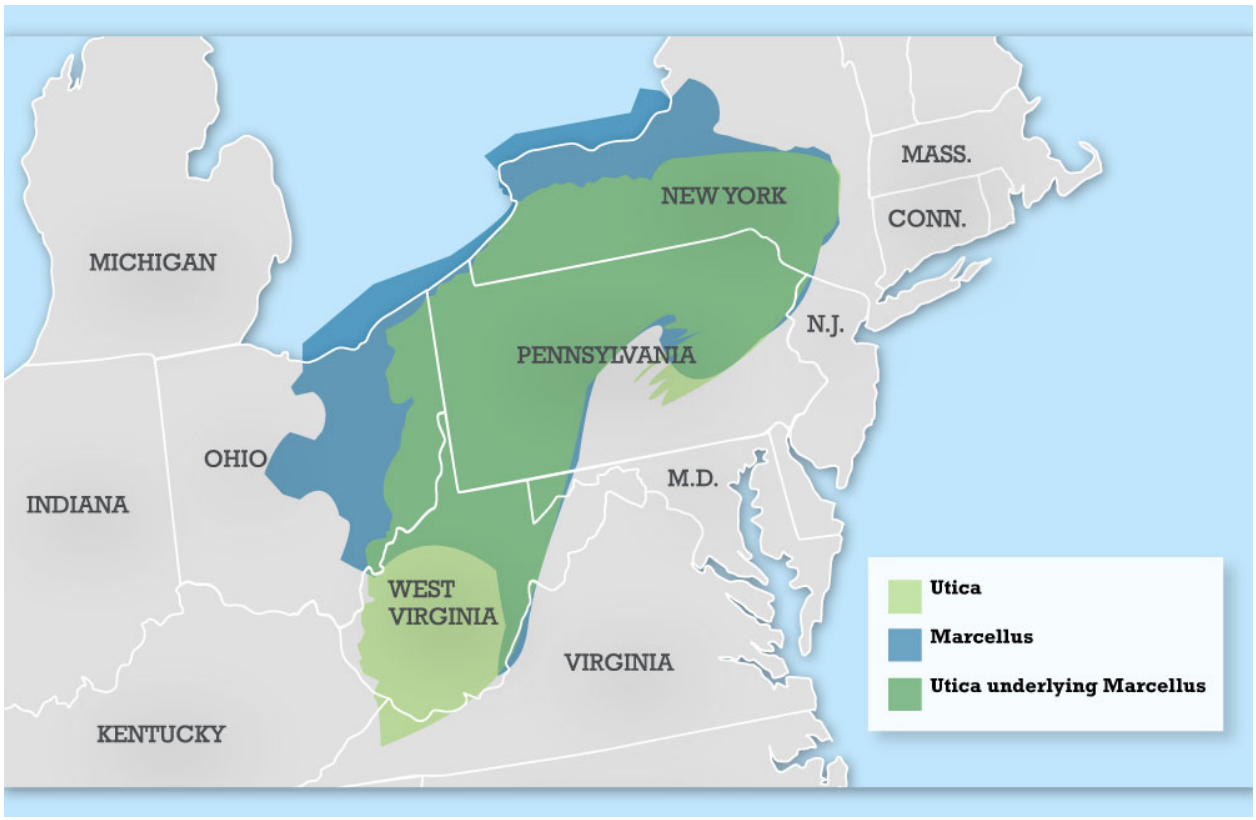
Steve, Roy. (2012) Containment of Wastes Under the Land Ban Program. Environmental Protections Agency. Web. Date Accessed, Dec. 16, 2014.

Figure 3: Abandoned Underground Mines of Ohio
Ohio Department of Natural Resources Geological Survey



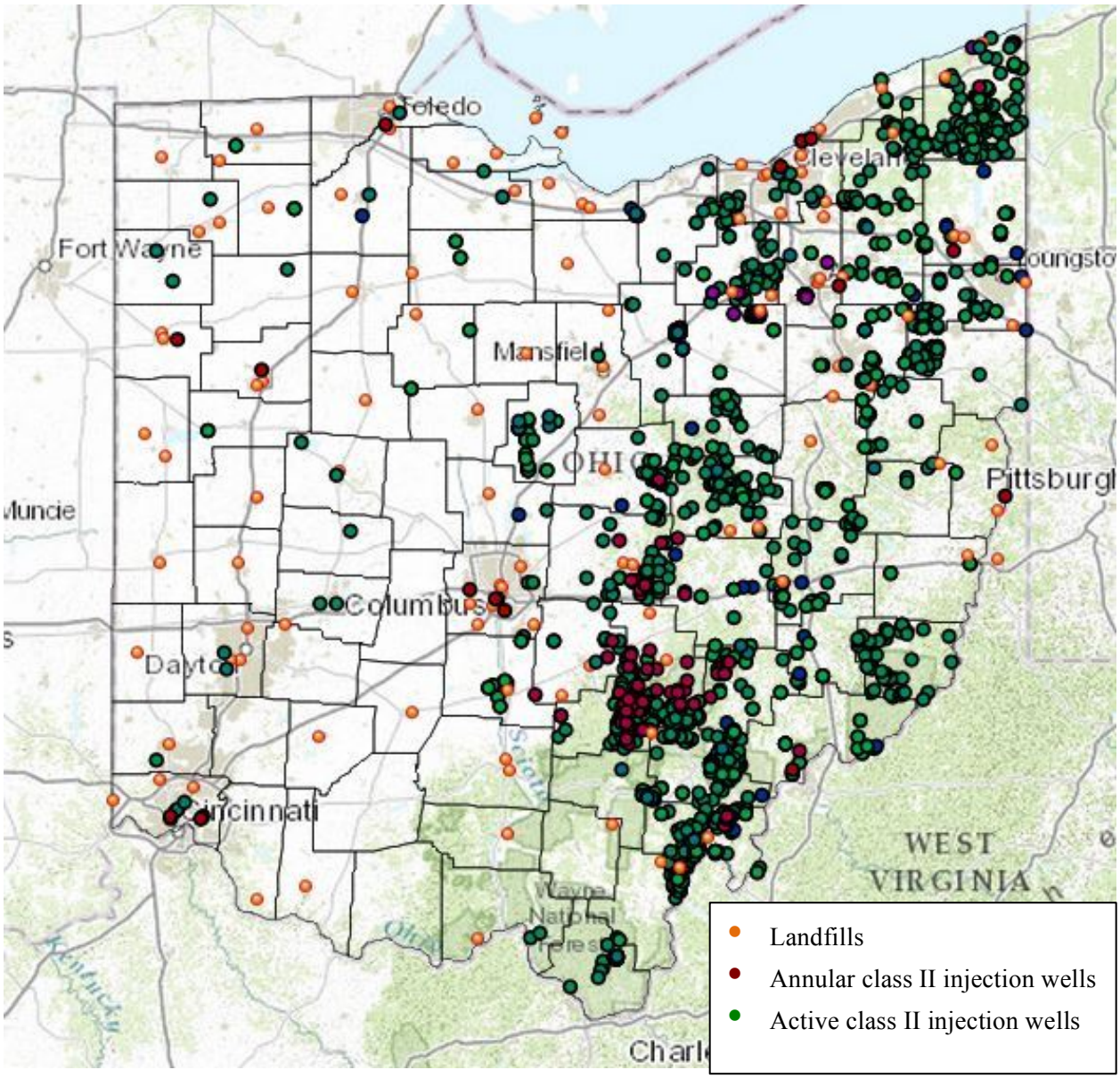
Ohio Division of Geological Survey, 2012, Abandoned Underground Mines of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map EG-3, generalized page-size version with text, scale 1:2,000,000, 2 p.

Figure 4: Utica and Marcellus Shale Formation Map



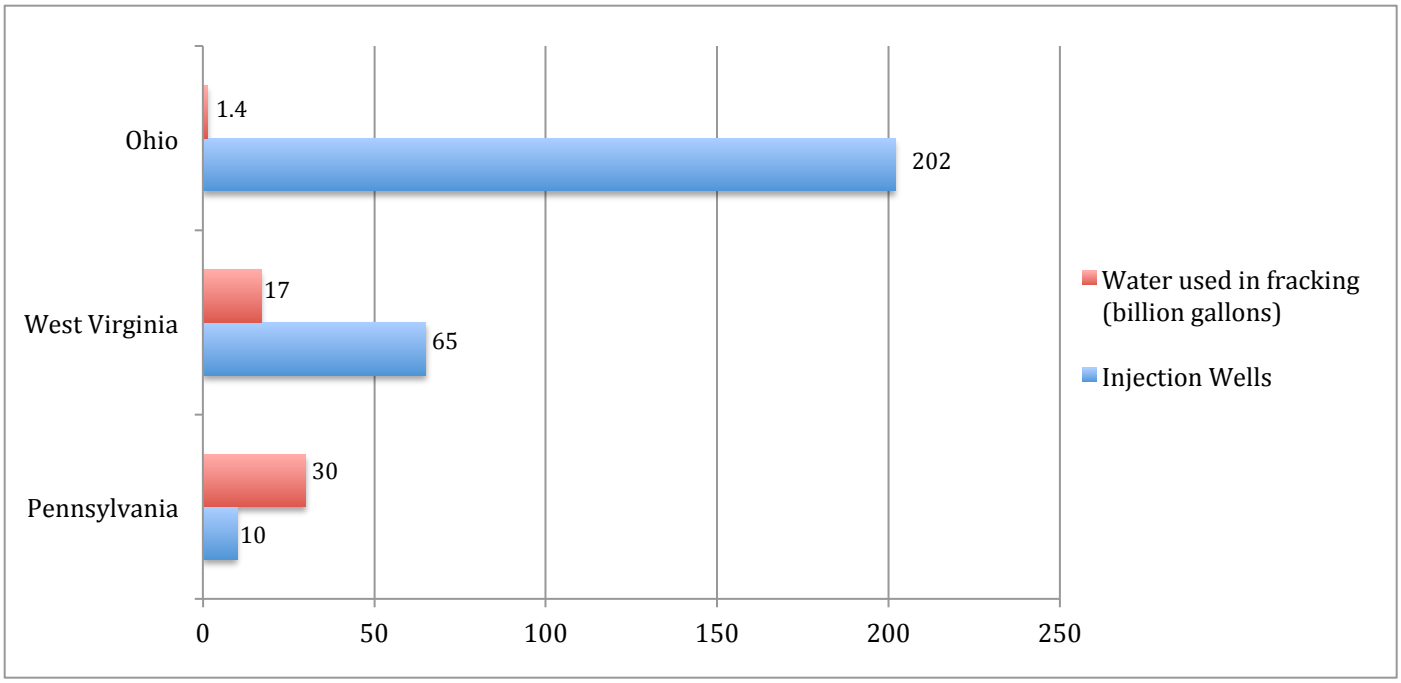
Marcellus and Utica Shale Formation Map. 2014. Scale not given. "The Marcellus Shale Coalition". http://marcelluscoalition.org/pa-map/

Figure 5: Injection Wells and Landfills in Ohio



Ohio Shale Gas Waste Disposal Network. (June 20, 2013). By The FrackTracker Alliance on FrackTracker.org. http://www.fractracker.org/2013/06/oh-waste-network/

Figure 6: Comparison Bar Graph of Injection Wells and Wastewater Produced by State



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